



[6450-01-P]

DEPARTMENT OF ENERGY

10 CFR Parts 429 and 430

[Docket No. EERE-2012-BT-TP-0046]

RIN: 1904-AC52

Energy Conservation Program: Test Procedure for Set-top Boxes

AGENCY: Office of Energy Efficiency and Renewable Energy, Department of Energy.

ACTION: Notice of proposed rulemaking.

SUMMARY: The U.S. Department of Energy (DOE) proposes to establish a new test procedure for set-top boxes (STBs). The proposed test procedure describes the methods for measuring the power consumption of STBs in the on, sleep (commonly known as standby mode), and off modes. Further, an annual energy consumption (AEC) metric is proposed to calculate the annualized energy consumption of the STB based on its power consumption in the different modes of operation. DOE has tentatively identified that the test methods described in the draft Consumer Electronics Association (CEA) standard, CEA-2043, “Set-top Box (STB) Power Measurement” are appropriate to use as a basis for developing the test procedure for STBs. The draft CEA-2043 standard specifies the test methods for determining the power consumption of a STB in the on, sleep, and off modes. The proposed test procedure in this rulemaking is primarily based on the draft CEA-2043 standard, which was issued as an email ballot to the members of the CEA working group developing the standard for a vote on November 27, 2012.

DATES: DOE will hold a public meeting on Wednesday, February 27, 2013, from 9 a.m. to 4 p.m., in Washington, DC. The meeting will also be broadcast as a webinar. See section V, “Public Participation,” for webinar registration information, participant instructions, and information about the capabilities available to webinar participants.

DOE will accept comments, data, and information regarding this notice of proposed rulemaking (NPR) before and after the public meeting, but no later than **[INSERT DATE 75 DAYS AFTER FEDERAL REGISTER PUBLICATION]**. See section V, “Public Participation,” for details.

ADDRESSES: The public meeting will be held at the U.S. Department of Energy, Forrestal Building, Room 8E-089, 1000 Independence Avenue, SW., Washington, DC 20585. To attend, please notify Ms. Brenda Edwards at (202) 586–2945. Please note that foreign nationals visiting DOE Headquarters are subject to advance security screening procedures. Any foreign national wishing to participate in the meeting should advise DOE as soon as possible by contacting Ms. Edwards to initiate the necessary procedures. Please also note that those wishing to bring laptops into the Forrestal Building will be required to obtain a property pass. Visitors should avoid bringing laptops, or allow an extra 45 minutes. Persons can attend the public meeting via webinar. For more information, refer to the Public Participation section near the end of this notice.

Any comments submitted must identify the NPR for the Test Procedure for Set-top Boxes, and provide docket number EERE-2012–BT–TP–0046 and/or regulatory information

number (RIN) number 1904-AC52. Comments may be submitted using any of the following methods:

1. Federal eRulemaking Portal: www.regulations.gov. Follow the instructions for submitting comments.
2. E-mail: SetTopBox2012TP0046@ee.doe.gov. Include the docket number and/or RIN in the subject line of the message.
3. Mail: Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, Mailstop EE-2J, 1000 Independence Avenue, SW., Washington, DC, 20585-0121. If possible, please submit all items on a CD. It is not necessary to include printed copies.
4. Hand Delivery/Courier: Ms. Brenda Edwards, U.S. Department of Energy, Building Technologies Program, 950 L'Enfant Plaza, SW., Suite 600, Washington, DC, 20024. Telephone: (202) 586-2945. If possible, please submit all items on a CD. It is not necessary to include printed copies.

For detailed instructions on submitting comments and additional information on the rulemaking process, see section V of this document (Public Participation).

Docket: The docket is available for review at regulations.gov, including Federal Register notices, framework documents, public meeting attendee lists and transcripts, comments, and other supporting documents/materials. All documents in the docket are listed in the regulations.gov index. However, not all documents listed in the index may be publicly available, such as information that is exempt from public disclosure.

A link to the docket web page can be found at:

http://www1.eere.energy.gov/buildings/appliance_standards/rulemaking.aspx/ruleid/33. This web page will contain a link to the docket for this notice on the regulations.gov site. The regulations.gov web page will contain simple instructions on how to access all documents, including public comments, in the docket. See section V for information on how to submit comments through regulations.gov.

For further information on how to submit a comment, review other public comments and the docket, or participate in the public meeting, contact Ms. Brenda Edwards at (202) 586-2945 or by email: Brenda.Edwards@ee.doe.gov.

FOR FURTHER INFORMATION CONTACT:

Mr. Jeremy Domm, U.S. Department of Energy, Office of Energy Efficiency and Renewable Energy, Building Technologies Program, EE-2J, 1000 Independence Avenue, SW, Washington, DC, 20585-0121. Telephone: (202) 586-9870. E-mail: Jeremy.Domm@ee.doe.gov.

Ms. Celia Sher, U.S. Department of Energy, Office of the General Counsel, GC-71, 1000 Independence Avenue, SW, Washington, DC, 20585-0121. Telephone: (202) 287-6122. E-mail: Celia.Sher@hq.doe.gov.

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I. Authority and Background

Title III of the Energy Policy and Conservation Act (42 U.S.C. 6291, et seq.; “EPCA” or, “the Act”) sets forth a variety of provisions designed to improve energy efficiency. (All references to EPCA refer to the statute as amended through the Energy Independence and Security Act of 2007 (EISA 2007), Pub. L. 110-140 (Dec. 19, 2007)). Part A of Title III of EPCA (42 U.S.C. 6291–6309) established the “Energy Conservation Program for Consumer Products Other Than Automobiles,” which covers consumer products and certain commercial products (hereafter referred to as “covered products”).¹ In addition to specifying a list of covered residential and commercial products, EPCA contains provisions that enable the Secretary of Energy to classify additional types of consumer products as covered products. (42 U.S.C. 6292(a)(20)) For a given product to be classified as a covered product, the Secretary must determine that:

Classifying the product as a covered product is necessary or appropriate to carry out the purposes of EPCA; and

¹ For editorial reasons, upon codification in the U.S. code, Part B was re-designated Part A.

The average annual per-household energy use by products of such type is likely to exceed 100kWh per year. (42 U.S.C. 6292(b)(1))

Under this authority, DOE published a notice of proposed determination (the 2011 proposed determination), that tentatively determined that STBs and network equipment qualify as a covered product because classifying products of such type as a covered product is necessary or appropriate to carry out the purposes of EPCA, and the average U.S. household energy use for STBs and network equipment is likely to exceed 100 kilowatt-hours (kWh) per year. 76 FR at 34914 (June 15, 2011).

DOE may prescribe test procedures for any product it classifies as a “covered product.” (42 U.S.C. 6293(b)) Under EPCA, the “Energy Conservation Program for Consumer Products Other Than Automobiles” consists essentially of four parts: (1) testing, (2) labeling, (3) Federal energy conservation standards, and (4) certification and enforcement procedures. The testing requirements consist of test procedures that manufacturers of covered products must use (1) as the basis for certifying to DOE that their products comply with the applicable energy conservation standards adopted under EPCA, and (2) for making representations about the efficiency of those products. Similarly, DOE must use these test requirements to determine whether the products comply with any relevant standards promulgated under EPCA.

General Test Procedure Rulemaking Process

Under 42 U.S.C. 6293, EPCA sets forth the criteria and procedures DOE must follow when prescribing or amending a test procedure for covered products. EPCA provides in relevant part that any test procedure prescribed or amended under this section shall be reasonably

designed to produce test results which measure energy efficiency, energy use or estimated annual operating cost of a covered product during a representative average use cycle or period of use and shall not be unduly burdensome to conduct. (42 U.S.C. 6293(b)(3))

In addition, if DOE determines that a test procedure amendment is warranted, it must publish a proposed test procedure and offer the public an opportunity to present oral and written comments on it. (42 U.S.C. 6293(b)(2)) Finally, in any rulemaking to amend a test procedure, DOE must determine to what extent, if any, the proposed test procedure would alter the measured energy efficiency of any covered product as determined under the existing test procedure. (42 U.S.C. 6293(e)(1)) If DOE determines that the amended test procedure would alter the measured efficiency of a covered product, DOE must amend the applicable energy conservation standard accordingly. (42 U.S.C. 6293(e)(2))

EPCA specifies that if the Secretary determines that a test procedure should be prescribed for a covered product, a proposed test procedure should be published in the Federal Register and interested persons should be provided an opportunity to present oral and written data, views, and arguments with respect to the proposed procedure. (42 U.S.C. 6293(b)(2)) Since DOE has tentatively determined that STBs are a covered product and a test procedure is required to determine the energy conservation standard for this product, a test procedure rulemaking is being undertaken to provide a test procedure to measure the energy consumption of STBs.

In addition to proposing a test procedure to measure the energy consumption of STBs in on mode, DOE is proposing test procedures to measure the energy consumption of STBs in sleep mode (an industry term that refers to standby mode) and off mode. This is consistent with EISA

2007, which amended EPCA to require DOE to implement a standby and off mode energy consumption measurement, if technically feasible, in new or existing test procedures that do not have this measurement. Otherwise, DOE must prescribe a separate standby and off mode energy test procedure, if technically feasible. (42 U.S.C. 6295(gg)(2)(A)) EISA 2007 also requires any final rule establishing or revising energy conservation standards for a covered product, adopted after July 1, 2010, to incorporate standby mode and off mode energy use into a single amended or new standard, if feasible. (42 U.S.C. 6295(gg)(3)(A)) DOE recognizes that the standby and off mode conditions of operation apply to STBs, the product covered by this proposed rule. Therefore, in response to this requirement, DOE proposes to adopt provisions in the test procedure to measure the energy use in standby and off mode for STBs. Because ‘sleep’ is the term used by industry for indicating that a STB is in standby mode, DOE is using the term ‘sleep mode’ to refer to standby mode in today’s NOPR. The proposed approach for measuring the power consumption in sleep and off modes is discussed in sections III.G.6 and III.G.7, respectively.

In June 2011, DOE published the 2011 proposed determination that tentatively determined that STBs and network equipment meet the criteria for covered products. 76 FR at 34914 (June 15, 2011). If DOE issues a final determination that STBs are a covered product, it may establish a test procedure and energy conservation standard for STBs. To initiate this rulemaking process, DOE published a request for information (RFI) document on December 16, 2011 (the 2011 RFI), requesting stakeholders to provide technical information regarding various test procedures used by industry to measure the energy consumption of STBs and network equipment. 76 FR at 78174. Such industry test procedures included the ENERGY STAR[®] program’s specification, ENERGY STAR Program Requirements for Set-top Boxes, Version 3.0

(ENERGY STAR specification)², Consumer Electronics Association's (CEA) standards ANSI³/CEA-2013-A⁴ and ANSI/CEA-2022⁵, Canadian Standards Association's (CSA) test procedure C380-08⁶, as well as International Electrochemical Commission's (IEC) standard IEC 62087⁷. Id. In the 2011 RFI, DOE also solicited comments on the key issues affecting the development of a new test procedure. Today's NOPR has been developed based on DOE's research and analysis of existing and draft versions of industry standards, that prescribe test procedures for testing STBs, as well as stakeholder responses to the key issues discussed in the 2011 RFI.

In this NOPR, DOE proposes measurement tests to determine the power consumption of STBs in the on, sleep, and off modes. Pursuant to the National Technology Transfer and Advancement Act of 1995 (Pub. L. 104–113), which directs Federal agencies to use voluntary consensus standards in lieu of Government standards whenever possible, DOE proposes a STB test procedure that has primarily been developed from the draft CEA-2043⁸ standard, currently under development by a CEA working group that includes representatives of the STB industry. This draft standard provides the definitions, measurement criteria, and test procedures for testing the specific modes of STBs. DOE also proposes a method for determining the ratings of power consumption in the on, sleep, and off modes for a given basic model of STB, which includes the

² ENERGY STAR® Program Requirements for Set-top Box Service Providers. Version 3.0. <www.energystar.gov/ia/partners/product_specs/program_reqs/STB_Version_3_Program_Requirements_Service_Providers.pdf?38d7-750d>

³ American National Standards Institute.

⁴ ANSI/CEA Standard. "Digital STB Background Power Consumption." ANSI/CEA-2013-A. July 2007.

⁵ ANSI/CEA Standard. "Digital STB Active Power Consumption Measurement." ANSI/CEA-2022. July 2007.

⁶ Canadian Standards Association. "Test Procedure for the Measurement of Energy Consumption of Set-top Boxes (STBs)." C380-08. August 2008.

⁷ International Standard. "Methods of measurement for the power consumption of audio, video and related equipment." Edition 3.0 2011-04. Section 8.

⁸ Draft CEA-2043. "Set-top Box (STB) Power Measurement." The version referenced in today's NOPR was issued as an email ballot, for vote, to the R04WG13 working group on November 27, 2012.

number of units that must be tested and the statistical tolerances. Finally, DOE proposes a metric to calculate the annual energy consumption (AEC) of the STB. DOE's proposed metric combines the rated values of STB power consumption in each mode of operation with the expected time spent in the respective mode. The time weightings used to calculate the typical energy consumption (TEC) in the ENERGY STAR specification were used as a starting point to develop the time weightings for the AEC metric proposed in today's NOPR.

II. Summary of the Notice of Proposed Rulemaking

In this NOPR, DOE proposes: (1) a test procedure for determining the energy consumption of STBs in the on, sleep, and off modes; (2) a method for determining the ratings of power consumption in the on, sleep, and off modes for a given basic model of STB; and, (3) a metric to calculate the AEC of the STB. DOE also proposes to exclude network equipment from the scope of this rulemaking, which is discussed in further detail in section III.B of this NOPR.

DOE's proposed test procedure for determining the energy consumption of the STB is largely developed from the draft CEA-2043 standard. The draft CEA-2043 standard was issued as an email ballot to CEA's working group members for vote on November 27, 2012. The standard specifies the definitions, measurement criteria, and the test methods for determining the power consumption of the STB in different modes of operation. DOE reviewed several approaches for testing the power consumption of STBs and determined that the test procedure specified in the draft CEA-2043 standard is representative and generates repeatable power consumption values. This determination was made based on discussions with industry experts as well as through DOE's internal research and analysis. Additionally, DOE has proposed some

modifications to the test procedure specified in the draft CEA-2043 standard as discussed in sections III.D through III.G.

DOE's proposed test procedure for determining the power consumption of a STB in on mode is comprised of two main tests: (1) an on (watch television (TV)) test that records the power consumption when a channel is viewed; and, (2) a multi-stream test that evaluates different functions of multi-streaming STBs depending on its capabilities, such as channel viewing, recording, and playback. The proposed tests for on mode are discussed in further detail in section III.G.5 of the NOPR. For testing the power consumption of the STB in sleep mode, DOE developed the test procedure from the sleep mode test procedure specified in the draft CEA-2043 standard. Sleep mode as defined in the CEA standard meets the definition of standby mode as outlined in EISA 2007. (42 U.S.C. 6295(gg)) As discussed in Authority and Background, section I of this NOPR, DOE proposes to use the industry term 'sleep' mode in place of standby for this test. For the sleep mode test, DOE proposes two tests: (1) a manual sleep test in which the STB enters sleep mode through a user action on the remote control; and, (2) an auto power down (APD) test in which the STB automatically enters sleep mode after a period of user inaction. For both sleep mode tests, an average power measurement over a period of at least 4 hours and up to a maximum of 8 hours is recorded as discussed in section III.G.6. For testing the power consumption of the STB in off mode, DOE proposes an average measurement over 2 minutes after the STB has been placed in off mode. The proposed off mode measurement test is discussed in further detail in section III.G.7.

In addition to proposing measurement tests to measure the power consumption of the STB in the different modes of operation, DOE is proposing a sampling plan that requires testing

of at least two STBs for each basic model, to determine the power consumption in each mode of operation and the application of tolerances for determining the rating of a given basic model, as discussed in further detail in section III.H.

Finally, DOE is proposing a metric to calculate the AEC of the STB from the rated power consumption in the on, sleep, and off modes of operation. The proposed metric combines the rated power consumption values of the STB in the different modes of operation into a single metric based on the expected time spent in each mode of operation such that it is representative of the STB's annual energy use. The time weightings used to calculate TEC in the ENERGY STAR specification were used as the starting point to develop the time weightings that are proposed for the AEC metric. DOE believes that the proposed test procedure will accurately represent the energy consumption of STBs by capturing the AEC in on, sleep, and off modes. The AEC metric is discussed in further detail in section III.I.

III. Discussion

A. Effective Date and Compliance Date of Test Procedure

If adopted, the effective date for this test procedure would be 30 days after publication of the test procedure final rule in the Federal Register. At that time, the new metrics and any other measure of energy consumption which depends on these metrics may be represented pursuant to the final rule. Compliance with the new test procedure and sampling plans for representation purposes would be required 180 days after the date of publication of the test procedure final rule. On or after that date, any such representations, including those made on marketing materials, websites (including qualification with a voluntary or State program), and product labels shall be

based upon results generated under the final test procedure proposed to be included in Appendix AA to Subpart B of 10 CFR Part 430 as well as the sampling plan in 10 CFR Part 429.

The final DOE test procedure shall be utilized or referenced by all other organizations, such as U.S. Environmental Protection Agency (EPA) for its ENERGY STAR specification for STBs, the California Energy Commission (CEC) and any other state regulation providing for the disclosure of information with respect to any measure of STB energy consumption once the test procedure becomes effective 30 days after the test procedure final rule publication. The final rule will supersede any existing state test procedure for STBs to the extent the state regulation requires testing in a manner other than that required by the final DOE test procedure. (42 U.S.C. 6297(a)(1))

B. Products Covered by This Rulemaking

In the 2011 RFI, DOE requested comment on the scope of the STB and network equipment test procedure rulemaking. DOE received some comments that network equipment should not be included in the scope of the rulemaking, and received some comments in favor of developing a Federal test procedure for STBs. Verizon commented that DOE should not identify network equipment as a covered product and should clarify that only “traditional, dedicated” STBs would be subject to any test procedure or energy conservation standard. (Verizon, No. 0032 at p. 5)⁹ The Consortium for Energy Efficiency (CEE) commented that they support the development of a test procedure for STBs that accurately measures STB energy consumption by

⁹ A notation in this form provides a reference for information that is in the docket of DOE’s rulemaking to develop a test procedure for STBs (Docket No. EERE–2011–BT–NOA–0067), which is maintained at www.regulations.gov. This notation indicates that the statement preceding the reference is document number [0032 as assigned in regulations.gov] in the docket for the STB test procedure rulemaking, and appears at page 5 of that document.

simulating actual usage by consumers. (CEE, No. 0028 at p. 1) Further, the joint response of DISH Network L.L.C. (DISH), EchoStar Technologies L.L.C. (EchoStar), and DIRECTV L.L.C. (DIRECTV), commented that this rulemaking should be limited to STBs and should not include network equipment. (DISH, EchoStar, DIRECTV, No. 0030 at p. 1) The National Cable & Telecommunications Association (NCTA) commented that if DOE proceeded with a rulemaking, the scope of this rulemaking should include STBs that are defined as any non-gateway devices. (NCTA, No. 0034 at p. 43) DOE also received a comment in support of a test procedure for network equipment. The joint comment response of Appliance Standards Awareness Project (ASAP), American Council for an Energy-Efficient Economy (ACEEE), and Consumer Federation of America (CFA) encouraged DOE to continue investigating both network equipment and STBs in order to realize energy savings for consumers as well as other economic and environmental benefits. (ASAP, ACEEE, CFA, No. 0025 at p. 1–5) These commenters did not recommend any specific test method for testing network equipment but suggested that DOE should look into existing test methods that were identified during the development of the ENERGY STAR specification for small network equipment.¹⁰ (ASAP, ACEEE, CFA, No. 0025 at p. 3)

Based on stakeholder feedback, DOE proposes to exclude network equipment from the scope of this NOPR and focus exclusively on STBs. DOE proposes that the scope of today's proposed rulemaking is to capture the energy consumption of STBs that primarily receive and

¹⁰ ENERGY STAR Small Network Equipment. "Draft Specification Framework Document." October 2009. <www.energystar.gov/ia/partners/prod_development/new_specs/downloads/small_network equip/SNE_Draft_Framework_V1_0.pdf?ecf4-2f7e>

output video content. DOE proposes to define STBs as described in section III.D.1 below. DOE will continue to evaluate the need for a test procedure for network equipment.

In addition to receiving comments on the overall scope of coverage of today's NOPR, DOE received comments about the exclusion of specific models of STBs. Sidley Austin LLP (Sidley Austin) commented that during a meeting between DOE, AT&T, and Sidley Austin on March 7, 2012, AT&T representatives suggested that AT&T's U-verse® receivers should not be covered under any test procedure or energy conservation standard rulemaking because the product already uses less power than other STBs and does not meet the annual 100 kWh statutory threshold set by EPCA for covered products to be regulated. (Sidley Austin LLP, No. 0024 at p. 2) Sidley Austin further commented that AT&T's U-verse® is one of the most energy efficient STBs on the market and is continuing to improve its efficiency. (Sidley Austin LLP, No. 0024 at p. 2) Next, AT&T commented that DOE should refrain from promulgating a test procedure or energy efficiency standard for Internet Protocol TV (IPTV) receivers because the energy use of IPTV STBs does not meet the statutory threshold for these boxes to be regulated. (AT&T, No. 0032 at p. 5) DOE considers that today's test procedure NOPR is applicable to any STB, including IPTV, as defined in section III.D.1 and will address the scope of coverage for any energy conservation standard during that rulemaking, if required.

DOE also received several comments on the coverage of low noise block-downconverters (LNBs), auxiliary boxes, optical network terminals (ONTs), and standalone digital video recorders (DVRs). The Natural Resources Defense Council (NRDC) recommended including all of these products in the scope of this rulemaking. (NRDC, No. 0017 at p. 2) NRDC further commented that once ONTs are installed, they are not removed when service is terminated. If a

customer switches to a service provider that does not require an ONT, this unit could continue drawing power without being used. (NRDC, No. 0017 at p. 2) Conversely, DISH, EchoStar, and DIRECTV commented that LNBs should not be included in the scope of this rulemaking. They commented that LNBs can consume varied power in different configurations. (DISH, EchoStar, DIRECTV, No. 0030 at p. 5) Further, the outdoor unit (ODU) that consists of a receiving dish, LNB, and radio frequency (RF) switch would need to be specified in detail to test these units in a repeatable fashion. Finally, the power consumption of the ODU devices varies with weather and location. (DISH, EchoStar, DIRECTV, No. 0030 at p. 11)

Because of the complexity associated with these equipment and the significant operational differences from STBs, DOE does not propose to include LNBs, ONTs, ODUs, or other infrastructure devices that do not directly deliver TV signals to a consumer display to be in the scope of this rulemaking.

DOE requests comment on focusing the scope of today's rulemaking to STBs and excluding network equipment. Further, DOE seeks additional information and comment related to the development of a test procedure for LNBs, ONTs, ODUs, or other infrastructure devices and the standard configuration in which these products should be tested.

C. Industry Set-top Box Test Procedures

While developing the proposed test procedure for STBs, DOE researched existing and draft test procedures that measure STB energy consumption, as discussed in the 2011 RFI. DOE received a comment from CEA stating that it should not duplicate the private sector's development of a consensus standard test procedure for measuring the power consumption of

STBs. (CEA, No. 0031 at p. 3) DOE agrees with CEA and is proposing a test procedure for STBs that is largely based on standards accepted and developed by industry. The standards that were reviewed to develop this test procedure NOPR include the ENERGY STAR specification, CEA standards ANSI/CEA-2013A, ANSI/CEA-2022, the draft CEA-2043 standard, CSA test procedure C380-08, as well as IEC standard IEC 62087.

The ENERGY STAR specification includes a test method for determining the power consumption of the STB in different modes of operation. The ENERGY STAR test method provides the test setup, test conduct, initialization requirements, and test procedures for testing the STB in many different modes of operation. These include, in the on mode: watching TV, recording to a DVR and removable media, and playing back recorded content from a DVR and removable media. In the sleep mode, the test procedures include: sleep mode, APD, and deep sleep. Finally, the ENERGY STAR test method also includes a method for testing a STB that has multi-room capability. The ENERGY STAR test method was developed based on the CSA test procedure, C380-08. DOE referred to some sections of the ENERGY STAR specification to develop today's NOPR, which are discussed in detail in sections III.D to III.I.

The ANSI/CEA-2022 and ANSI/CEA-2013A provide an overview to determine the power consumption of STBs in the on, sleep and off modes, respectively. The standards do not contain detailed information about testing and setup for the different modes of operation. As discussed, CEA is also developing a new standard, CEA-2043, that is currently in draft form but will supersede CEA standards ANSI/CEA-2013A and ANSI/CEA-2022 once it is published. Therefore, DOE did not refer to ANSI/CEA-2013A and ANSI/CEA-2022 to develop today's proposed rule; instead it refers to the draft CEA-2043 standard.

The CSA test procedure, C380-08, specifies test conditions and setup requirements that are also referenced in the ENERGY STAR specification and are the same as those specified in the draft CEA-2043 standard. The C380-08 standard specifies test procedures for determining energy consumption in the on and sleep modes of operation, from which the ENERGY STAR specification was developed. Therefore, DOE does not reference this CSA test procedure in the NOPR because the information specified in the CSA test procedure is also included in the ENERGY STAR specification.

IEC 62087 provides specification for testing the STB at different input signal levels and different input terminals depending on the type of the STB. The standard provides test procedures for determining power consumption in the on and sleep modes. In the on mode, IEC 62087 specifies tests in the play, record, and multi-function (with single and multiple tuners) modes. In sleep mode, it specifies tests at the active high, active low, and passive modes. DOE refers to IEC 62087 to support some of its proposed requirements.

DOE primarily focused on the draft CEA-2043 standard to develop the test procedure for STBs that is proposed in this NOPR. The draft CEA-2043 standard specifies the test conditions and test setup at which power consumption of the STB should be measured. These include the modes of operation of the STB, test room and equipment requirements, and measurement tests for determining the power consumption in each mode of operation. DOE also referred to the ENERGY STAR specification to develop some of the proposed requirements, such as the AEC metric, that are not specified in the draft CEA-2043 standard. In review of CEA-2043, DOE found that CEA is a leading organization that connects consumer electronics manufacturers, retailers, and other interested parties to develop industry accepted electronics test procedures.

The CEA Technology & Standards program is CEA's standards making body that is accredited by ANSI.¹¹ CEA-2043 is being developed under the CEA R04 WG13 STB Energy Consumption working group, which falls under the CEA Technology & Standards program. DOE representatives have observed the development of CEA-2043, attended conference call meetings between STB manufacturers and energy advocates during draft revisions, and have been included on all notes and documentation from the CEA R04 WG13 STB Energy Consumption working group. Today's NOPR has primarily been developed using the draft version of the CEA-2043 standard that was issued as an email ballot to members of the working group for a vote on November 27, 2012. However, DOE is proposing some modifications, which are discussed in sections III.D through III.G.

The draft version of the CEA-2043 standard was in a 30 day voting period that ended on December 28, 2012. Once the final CEA-2043 standard is published, it will be available on CEA's website at <http://www.ce.org/Standards/Standard-Listings.aspx>. DOE requests comment on using the draft CEA-2043 standard as the basis for today's proposed test procedure for STBs.

D. Definitions

1. Definition of Set-top Boxes

Because there are no statutory definitions for STBs under EPCA currently, DOE proposes to develop a definition for STBs. Cisco commented that defining STBs as traditional STBs would capture only some of the ways in which video program is delivered and a broader definition that is designed to encompass all means by which a consumer could receive video

¹¹ "ANSI-Accredited Standard Developers."
<www.ansi.org/about_ansi/accredited_programs/overview.aspx?menuid=1>

signals from multichannel video programming distributors (MVPD) could inadvertently bring tablet computers, computers, gaming consoles, and smartphones under this regulation. (Cisco Systems, Inc., No. 0027 at p. 11) DOE understands these concerns and is proposing a definition that captures more than just traditional STBs, while mitigating the issues associated with a broader definition of STBs. The proposed definition would be included in 10 CFR Part 430.2 and would define STBs as “a device combining hardware components with software programming designed for the primary purpose of receiving television and related services from terrestrial, cable, satellite, broadband, or local networks, providing video output using at least one direct video connection.”

DOE also proposes to include a definition for direct video connection, in 10 CFR Part 430.2, as “any connection type that is one of the following: High-Definition Multimedia Interface (HDMI), Component Video, S-Video, Composite Video, or any other video interface that may be used to output video content.”

DOE’s proposed definition of STBs is different from the definition specified in section 4 of the draft CEA-2043 standard. That standard defines a STB as “a device that receives video content which is then delivered to a display device, recording device, or client”. DOE did not adopt CEA’s definition in the NOPR because DOE believes the definition is vague and can include such devices in the scope of this rulemaking that are not, in fact, STBs. According to the definition specified in the draft CEA-2043 standard, any device that can receive video content and can deliver it to display device, recording device, or client is a STB. Under this definition, devices such as a smartphone could potentially be included under the scope. DOE believes these devices should not be included because the scope of today’s rulemaking is to capture the energy

use for those devices that primarily receive and output video content. Because the primary use of a device such as a smartphone or gaming console is not to output video content, today's test procedure would not make adequate energy representations of these products. DOE believes that smartphones do not meet the definition of a STB under today's proposed definition.

DOE does not propose to use the definition specified in the draft CEA-2043 standard. Instead, DOE developed a definition for STBs that includes specific detail about the types of networks the device can receive video content from and the allowable output connections for delivering the video content. The types of networks from which content could be received – terrestrial, cable, satellite, broadband, or local networks – are all networks that are commonly used for STBs. In fact, STBs are often defined by their base type functionality, which generally includes the network type used. This information was also included in the definition for STBs in an older draft of the CEA-2043 standard and DOE proposes to include it to add specificity to the STB definition. Additionally, DOE's proposed definition refers to a device that is manufactured when both the hardware components and the software is loaded on the device such that its primary purpose is receiving and outputting video. DOE believes it is important for the definition of a STB to include both software and hardware because the underlying hardware for a STB could look much like a general purpose computer, but the software added to such hardware distinguishes the unit allowing it to function as a STB. Further, the proposed DOE definition does not include specific devices to which the content is delivered, while the draft CEA-2043 definition specifies that the content is delivered to a display device, recording device, or client. In lieu of specifying the types of devices to which the content may be delivered, DOE's proposal specifies the types of video connections that may be used, since, at a minimum, a STB must deliver content to a video device. Including detail about the direct video connections that are

permissible ensures that devices that do not primarily deliver content to a video device do not meet the proposed definition. For example, devices that receive and transmit information solely through a network interface and do not have a video output would not be considered a STB under DOE's proposed regulatory definition, but would be considered a STB if the draft CEA-2043 standard's definition were adopted. DOE believes that today's proposed test procedure would not make appropriate representations of energy consumption for devices that do not provide a direct video output, and therefore, has proposed this definition to narrow the scope compared to the CEA-2043 standard.

Finally, to further aid in defining the scope of coverage of this rulemaking, DOE proposes to include definitions for Component Video, Composite Video, HDMI, and S-Video in the test procedure. These terms are all used in the definition for direct video connection, which is used to define STBs. DOE proposes to define these terms in section 430.2 of subpart A of 10 CFR part 430 as follows:

Component Video: Component Video is a video display interface that meets the specification in CEA-770.3-D.

Composite Video: Composite Video is a video display interface that uses a Radio Corporation of America (RCA) connection to transmit National Television System Committee (NTSC) analog video.

HDMI: High-Definition Multimedia Interface or HDMI is an audio/video interface that meets the specification in HDMI Specification Version 1.0.

S-Video: S-Video is a video display interface that transmits analog video over two channels: luminance and color.

For the definitions of Component Video and HDMI, DOE proposes to incorporate by reference two industry standards that are used to define these terms. Specifically, DOE proposes to define Component Video as a connection that meets the requirements found in CEA-770.3-D¹². For HDMI, DOE is proposing to define it as a connection that meets the requirements found in the HDMI Specification Version 1.0¹³. DOE believes these industry standards provide the appropriate information for defining the Component Video and HDMI connections and has therefore incorporated these standards by reference in section 430.3 of Subpart A of 10 CFR Part 430.

In the 2011 proposed determination, DOE proposed a definition for STBs and network equipment as “a device whose principal function(s) are to receive television signals (including, but not limited to, over-the-air, cable distribution system, and satellite signals) and deliver them to another consumer device, or to pass Internet Protocol traffic among various network interfaces.” 76 FR at 34915 (June 15, 2011). DOE received several comments about this definition from stakeholders. The Northwest Energy Efficiency Alliance (NEEA) suggested a new definition for STBs that accounts for the fact that these devices serve a broader function than to simply relay TV signals. (EERE-2010-BT-DET-0040, NEEA, No. 0006 at p. 2) AT&T and the California Investor Owned Utilities (CA IOUs) commented that DOE should adopt the

¹² CEA Standard. “High Definition TV Analog Component Video Interface.” CEA-770.3-D. Approved February 2008.

¹³ “High-Definition Multimedia Interface Specification.” Informational Version 1.0. Approved September 4, 2003.

definition of STB that has been developed by the ENERGY STAR program because it is well known by industry. (EERE-2010-BT-DET-0040, AT&T, No. 0008 at p. 9) (EERE-2010-BT-DET-0040, CA IOUs, No. 0011 at p. 2) Further, the Northeast Energy Efficiency Partnerships (NEEP) commented that STBs and network equipment should have a single definition because they perform similar functions. (EERE-2010-BT-DET-0040, NEEP, No. 0010 at p. 2) In contrast, the CA IOUs commented that separated definitions should be adopted for STBs and network equipment to explicitly describe the products covered. (EERE-2010-BT-DET-0040, CA IOUs, No. 0011 at p. 2) NCTA commented that STBs and network equipment vary too much to fit under one definition and that network equipment should be dropped from the rulemaking. (EERE-2010-BT-DET-0040, NCTA, No. 0017 at p. 8, 22) NRDC commented that the part of the definition that states “the principal function(s) are to receive TV signals” should be expanded because STBs receive more types of signals than TV signals. (EERE-2010-BT-DET-0040, NRDC, No. 0012 at p. 5) CEA commented that DOE should adopt the definition that will be specified in the new CEA standard and should compare the proposed STB definition to the Federal Communications Commission’s (FCC) definition of “navigation device” to avoid defining the same product category differently. (EERE-2010-BT-DET-0040, CEA, No. 0014 at p. 3) CEA also commented that the definition of STBs should not include a device with gateway functionality, such as devices that terminate the service provider or IP network for multiple devices in a home, because such a definition would combine video and non-video related devices and would include many different products such as networking switch, hub, Wireless-Fidelity (Wi-Fi)¹⁴ access point, Ethernet extending devices, and possibly the entire category of home automation, security and smart grid products. (EERE-2010-BT-DET-0040, CEA, No. 0014 at p.

¹⁴ Wi-Fi technology allows electronic devices to use radio waves to exchange data wirelessly over a computer network using the Institute of Electrical and Electronics Engineers (IEEE) 802.11 standards.

4) Finally, CEA, Verizon, and the Telecommunications Industry Association (TIA) commented that the phrase “to pass Internet Protocol traffic among various network interfaces” should be excluded from the proposed definition as they believe the scope of the rulemaking is to only cover video related devices. (EERE-2010-BT-DET-0040, Verizon, No. 0015 at p. 4) (EERE-2010-BT-DET-0040, TIA, No. 0040 at p. 4)

DOE reviewed the comments it received on the 2011 proposed determination and preliminarily concluded that it will not continue with the definition proposed for STBs and network equipment in the 2011 proposed determination, for the following reasons. First, the intent of the proposed definition in the 2011 proposed determination was that it be broad enough so that it covered both STBs and network equipment. However, as discussed in section III.B, today’s proposed rule narrows the scope of the rulemaking to cover only STBs and not network equipment. Second, DOE believes that the definition in the 2011 proposed determination may be too broad for the purposes of the STB test procedure rulemaking. The definition of “principal function” could be ambiguous; it is not explicit whether the principal function is based on how the device is used by the consumer or how the manufacturer intends the device to be used. Further, the definition in the 2011 proposed determination does not explicitly state that video content should be delivered using a direct video connection, which is included in the definition proposed in today’s NOPR. As discussed previously, specifying that the device should deliver video content using a direct video connection ensures that devices that do not use this connection are excluded from the proposed definition of STB. Therefore, DOE has proposed a new definition solely for STBs as discussed in the above paragraph.

DOE also considered defining a STB using the base types included in the ENERGY STAR specification. However, the ENERGY STAR definition is more suited to differentiating product types for the purposes of efficiency levels, which is not necessary when it comes to defining scope of coverage for DOE's regulatory program.

In conclusion, DOE proposes to define STBs as “a device combining hardware components with software programming designed for the primary purpose of receiving television and related services from terrestrial, cable, satellite, broadband, or local networks, providing video output using at least one direct video connection.” DOE invites comment on this proposed definition of STBs. In particular, DOE requests comment about whether the proposed definition is specific enough to exclude non-STB devices such as gaming consoles and smartphones, yet broad enough to cover traditional STBs as well as newer STBs. DOE also requests comment on the proposed definitions for direct video connection, Component Video, Composite Video, HDMI, and S-Video.

2. Basic Model of an STB

In March 2011, DOE published a final rule for ‘Certification, Compliance, and Enforcement for Consumer Products and Commercial and Industrial Equipment’. 76 FR at 12422 (March 7, 2011). In this rule, DOE codified a definition for basic model in 10 CFR Part 430.2 as follows:

“Basic model means all units of a given type of covered product (or class thereof) manufactured by one manufacturer, having the same primary energy source, and which have

essentially identical electrical, physical, and functional (or hydraulic) characteristics that affect energy consumption, energy efficiency, water consumption, or water efficiency; and

(1) With respect to general service fluorescent lamps, general service incandescent lamps, and incandescent reflector lamps: Lamps that have essentially identical light output and electrical characteristics—including lumens per watt (lm/W) and color rendering index (CRI).

(2) With respect to faucets and showerheads: Have the identical flow control mechanism attached to or installed within the fixture fittings, or the identical water-passage design features that use the same path of water in the highest flow mode.”

For today’s NOPR, DOE reviewed this definition of a basic model and has determined that the definition of basic model codified in 10 CFR Part 430.2 is applicable to STBs. For STBs, the ‘identical electrical, physical, and functional characteristics’ that identify two units as being the same basic model would also cover software download or hardware integration. This is because hardware components and software programming can change the functional or physical characteristics of the box that affect energy consumption and/or energy efficiency. Thus, in order for multiple STBs to be in the same basic model they must have essentially the same software downloads and hardware integration. Additionally, for today’s proposed rule, DOE also believes that two STB units are considered to be the same basic model if they have the same multi-streaming and DVR functionality as described in section III.D.4.

DOE invites comment on the discussion of basic model as it pertains to the STB rulemaking.

3. Manufacturer of a Set-top Box

DOE considers today's proposed test procedure applicable to any person that meets the definition of manufacturer under EPCA as it relates to STBs. EPCA defines the term "manufacture" as "to manufacture, produce, assemble, or import." (42 U.S.C. 6291(10)) The proposed definition of a STB itself is discussed in section III.D.1 of the NOPR.

4. Other Definitions

For the STB test procedure NOPR, DOE proposes to define terms that are relevant for the test procedure based on the definitions specified in section 4 of the draft CEA-2043 standard. Of these definitions, DOE proposes clarifying information, beyond what is provided in the draft CEA-2043 standard, for the definitions of DVR, display device, and home network interface (HNI). Additionally, DOE is including new definitions for content provider and multi-stream. The proposed definitions are included in section 2 (Definitions) of the proposed Appendix AA to Subpart B of 10 CFR Part 430. All proposed definitions are listed below, followed by a discussion of any differences from the draft CEA-2043 standard.

Auto power down (APD): A STB feature that monitors parameters correlated with user activity or viewing. If the parameters collectively indicate that no user activity or viewing is occurring, the APD feature enables the STB to transition to sleep or off mode.

Client: Any device (example: STB, thin-client STB, smart TV¹⁵, mobile phone, tablet, or personal computer) that can receive content over a home network interface (HNI).

Content provider: An entity that provides video programming content.

Crest factor: The ratio of the peak current to the root-mean-square (rms)¹⁶ current.

Digital video recorder (DVR): A STB feature that records TV signals on a hard disk drive (HDD) or other non-volatile storage device integrated into the STB. A DVR often includes features such as: Play, Record, Pause, Fast Forward (FF), and Fast Rewind (FR). STBs that support a service provider delivery network based “DVR” service are not considered DVR STBs for the purposes of this test procedure. The presence of DVR functionality does not mean the device is defined to be a STB.

Display device: A device (example: TV, Computer Monitor, or Portable TV) that receives its content directly from a STB through a video interface (example: HDMI, Component Video, Composite Video, or S-Video), not through a home network interface (HNI), and displays it for viewing.

Harmonic: A component of order n of the Fourier series¹⁷ that describes the periodic current or voltage (where n is an integer greater than 1).

¹⁵ A smart TV is a hybrid TV that combines internet features into modern TVs and STBs.

¹⁶ Rms current is a statistical measure of the magnitude of a current signal. Rms current is equal to the square root of the mean of all squared instantaneous currents over one complete cycle of the current signal.

High definition test stream (HD): Video content delivered to the STB by the content provider to produce a minimum output resolution of 1280×720 pixels in progressive scan mode¹⁸ at a minimum frame rate of 59.94 frames per second (fps) (abbreviated 720p60) or a minimum output resolution of 1920×1080 pixels in interlaced scan mode at 29.97 fps (abbreviated 1080i30).

Home network interface (HNI): An interface with external devices over a local area network (example: IEEE 802.11 (Wi-Fi), Multimedia over Coax Alliance (MoCA)¹⁹, HomePNA Alliance (HPNA)²⁰, IEEE 802.3²¹, or HomePlug AV²²) that is capable of transmitting video content.

Low noise block-downconverter (LNB): A combination of low-noise amplifier, block-downconverter and intermediate frequencies (IF) amplifier. It takes the received microwave transmission, amplifies it, down-converts the block of frequencies to a lower block of IF where the signal can be amplified and fed to the indoor satellite TV STB using coaxial cable.

¹⁷ A Fourier series decomposes period functions or period signals in terms of an infinite sum of simple oscillating functions, such as sines and cosines.

¹⁸ Progressive scan mode is a method of displaying, storing, or transmitting moving images such that all lines in each frame are drawn in sequence.

¹⁹ MoCA is a trade group that promotes a standard that uses coaxial cables to connect consumer electronic products and home networking devices. The connection allows both data communication and the transfer of audio and video streams. It is the only home entertainment networking standard used by all three pay TV segments, such as, cable, satellite, and IPTV.

²⁰ HPNA is an incorporated non-profit industry association of companies that develops home networking specifications for distributing entertainment and data over existing coaxial cables and telephone wiring within homes.

²¹ IEEE 802.3 is a working group that develops standards for Ethernet based local area networks.

²² HomePlug is an industry alliance that provides specifications that support networking over existing home electrical wiring. HomePlug AV is a specification that provides sufficient bandwidth for applications such as high definition TV (HDTV) and voice over IP (VoIP).

Multi-stream: A STB feature that may provide independent video content to one or more clients, one or more directly connected TVs, or a DVR.

Outdoor unit (ODU): Satellite signal reception components including: a receiving dish, one or more LNBs, and imbedded or independent radio frequency (RF) switches, used to distribute a satellite service provider network to consumer satellite STBs.

Point of deployment (POD) module: A plug-in card that complies with the ANSI/SCTE²³ 28²⁴ interface and is inserted into a digital-cable-ready device to enable the decryption of services and provide other network control functions.

Power mode: A condition or state of a device that broadly characterizes its capabilities, power consumption, power indicator coding, and responsiveness to input.

Principal STB function: Functions necessary for selecting, receiving, decoding, decompressing, or delivering video content to a display device, DVR, or client. Monitoring for user or network requests is not considered a principal STB function.

Satellite STB: a STB that receives and decodes video content as delivered from a service provider satellite network.

²³ The Society of Cable Telecommunications Engineers, Inc.

²⁴ Society of Cable Telecommunications Engineers. Engineering Committee. Digital Video Subcommittee. "HOST-POD Interface Standard." American National Standard.

Service provider: A business entity that provides video content, a delivery network, and associated installation and support services to subscribers with whom it has an ongoing contractual relationship.

Smart Card: A plug-in card that complies with ISO²⁵/IEC 7816-12²⁶ and is inserted into a satellite STB to enable the decryption of services and provide other network control functions.

Standard definition test stream (SD): Video content delivered to the STB by the content provider to produce an output resolution of 640 × 480 pixels in interlaced scan mode at minimum frame rate of 29.97 fps (abbreviated 480i30).

Thin-client STB: A STB that can receive content over an HNI from another STB, but is unable to interface directly to the service provider network.

DOE proposes to incorporate by reference the industry standards that are used in the definitions of POD and smart card. These standards are: ANSI/SCTE 28 for the definition of POD and ISO/IEC 7816-12 for the definition of Smart Card. These industry standards are part of the definition provided in the draft CEA-2043 standard, and DOE believes the standards provide necessary information to define the POD and Smart Card plug-in cards.

The definition of DVR in the draft CEA-2043 standard is, “a STB feature that records TV signals on a hard disk drive (HDD) or other non-volatile storage device. A DVR often includes

²⁵ International Organization for Standardization.

²⁶ International Standard. “Identification cards – Integrated circuit cards – Part 12: Cards with contacts – USB electrical interface and operating procedures.”

features such as: Play, Record, Pause, Fast Forward (FF), and Fast Rewind (FR). STBs that support a service provider delivery network based “DVR” service are not considered DVR STBs for the purposes of this test procedure. The presence of DVR functionality does not mean the device is defined to be a STB.” The definition of DVR in the draft CEA-2043 standard does not explicitly state that the HDD should be integrated into the STB, while DOE’s proposed definition adds the specification that the HDD or other non-volatile storage device shall be integrated into the STB. DOE has included this information to explicitly state that this proposed rule does not consider STBs with an external HDD as STBs with DVR capability. This requirement is similar to the ENERGY STAR specification and has been included in today’s proposed DVR definition because external storage devices are usually optional, and existing test procedures do not address how to test STBs with the external HDD attached.

In today's NOPR, DOE is proposing only to test STBs with integrated storage as a DVR. For STBs that support DVR only through an external storage device, DOE is proposing to test these basic models as a STB without DVR. There are currently a wide selection of external storage devices that can be paired with a STB to support DVR functionality, and DOE believes the choice of external storage device paired with the unit could impact the energy consumption of the STB itself. While DOE's preferred approach is to test the STB without DVR capabilities if they use an external storage device, DOE did consider an alternative that would capture this use. For testing purposes, DOE could specify the external storage device such as the storage device that is shipped with the STB or specifying a standard storage device that is for testing all applicable STBs across the board. DOE requests comment on the proposed approach of not testing STBs with external storage as a DVR. If DOE does consider testing the STB with an

external storage device as a DVR in response to comments, DOE specifically requests comments on the proper external storage device to use.

The definition of display device in the draft CEA-2043 standard is, “a display device (example: TV, Computer Monitor, or Portable TV) receives its content directly from a STB through a video interface (example: HDMI, Component Video, Composite Video, or S-Video), and not through a home network interface (HNI).” DOE’s proposed definition of a display device adds clarification that the content that is received from the STB through a video interface is displayed for viewing. DOE proposes to include this clarification to the definition of display device, because the definition specified in the draft CEA-2043 standard explains the functionality of a display device but does not explicitly define the device itself.

The definition of HNI in the draft CEA-2043 standard is, “the interface with external devices over a local area network (example: IEEE 802.11 (Wi-Fi), MoCA, HPNA, IEEE 802.3, or HomePlug AV).” DOE proposes to include clarifying information in the definition of HNI to explain that the interface is capable of transmitting video content. DOE believes that the definition in the draft CEA-2043 standard, which specifies that HNI is the interface with external devices over a local area network, is vague and could potentially include other interfaces that may not be capable of transmitting video content, and therefore, not applicable for connecting with a STB. Therefore, DOE is proposing to clarify that the HNI connection should be such that is capable of transmitting video content.

Finally, DOE proposes to include a definition for content provider and multi-stream that is not included in the draft CEA-2043 standard. DOE is proposing a definition for content

provider because the term is used in today's proposed test procedure to explain the type of content that should be streamed to a connected display device or client. DOE's proposed definition for multi-stream was adopted from an older version of the draft CEA standard, which included this definition. While CEA has removed the definition for multi-stream from the most recent version of the draft, DOE proposes to include it in this NOPR because DOE uses the definition to describe STBs that have multi-streaming capability and also proposes a multi-stream test to determine the power consumption of such STBs (section III.G.5.b).

In addition to the definitions adopted from the draft CEA-2043 standard, DOE proposes to include the terms ANSI, IEC, ISO, and SCTE in the definition section of the proposed Appendix AA to Subpart B of 10 CFR Part 430. These terms are used in the definitions of POD and Smart Card and therefore, DOE has included the full forms of these terms.

DOE invites interested parties to comment on the proposed definitions for the STB test procedure NOPR, and, in particular, the clarifying information included for the definitions of DVR, display device, HNI, and the definitions included for content provider and multi-stream.

5. Definitions of Power Modes

While power mode is defined in section III.D.4 above, DOE proposes to define the different modes of operation for the STB in further detail similar to those provided in section 6 of the draft CEA-2043 standard. The draft CEA-2043 standard describes the on, sleep, and off modes of STB operation, which are defined and discussed below. The proposed power mode definitions would be included in section 2.25 (Definition of Power Modes) of the proposed

Appendix AA to Subpart B of 10 CFR Part 430. DOE invites interested parties to comment on the proposed definitions for each mode of operation of the STB.

On mode: The STB is connected to a mains power source. At least one principal STB function is activated and all principal STB functions are provisioned for use. The power consumption in on mode may vary based on specific use and configuration.

DOE's view is that a STB has "all principal STB functions provisioned for use" if all principal STB functions are prepared or equipped for use by the consumer. This description of on mode aligns with the consumer's expectation of what a STB should do when it is turned on, or when it is "in-use". The proposed definition also aligns with the definition in the ENERGY STAR specification for on mode operation.

Sleep mode: A range of reduced power states where the STB is connected to a mains power source and is not providing any principal STB function. The STB may transition to on or off mode due to user action, internal signal, or external signal. The power consumed in this mode may vary based on specific use or configuration. If any principal STB function is activated while operating in this mode, the STB is assumed to transition to on mode. Monitoring for user or network requests is not considered a principal STB function. The STB shall be able to transition from this mode to on mode within 30 seconds, to be considered in sleep mode.

The proposed definition for sleep mode is similar to the definition for sleep mode in the draft CEA-2043 standard with one key addition. The proposal that the STB should transition to on mode within 30 seconds has been included to ensure that a valid sleep mode includes the

ability to resume full functionality in a timely manner. DOE received a comment from AT&T in response to the 2011 RFI that referenced consumer studies to indicate strong consumer resistance to any recovery time from “minimum power” mode longer than 1 minute. (AT&T, No. 0032 at p. 16) AT&T further indicated that this was true even when the consumer was prompted that longer recovery times would have environmental and energy saving benefits. (AT&T, No. 0032 at p. 16) Additionally, CA IOUs indicated that long wake times are a significant barrier to consumer adoption. (CA IOUs, No. 0033 at p. 6) NCTA also commented that a STB could take much longer than 2 to 5 minutes if the STB were to shut off power completely, which would negatively impact the user’s experience. (NCTA, No. 0034 at p.14)

Because the overall energy consumption of a STB is dependent on consumer adoption of sleep modes that can resume functionality quickly, DOE proposes to set a maximum allowable transition time of 30 seconds from sleep mode to on mode, which is half the acceptable duration referenced in AT&T’s studies. If the STB cannot transition from sleep mode to on mode in 30 seconds or less, it is not considered to have sleep mode capability and shall not be tested for the energy consumption in sleep mode, which is discussed in section III.G.6. That is, if the STB does not transition from sleep mode to on mode within 30 seconds, the value of the power consumption in sleep mode for the AEC metric (discussed in detail in section III.I of the NOPR) would be set equal to the power consumption in on (watch TV) mode for such STBs. It is DOE’s view that market forces will drive STBs to utilize a shorter transition period; however, DOE adds this limit as an upper bound to facilitate consumer adoption of sleep mode. If a STB takes very long to resume functionality from sleep mode, it is DOE’s assumption that consumers are less likely to place the STB in sleep mode. The 30 second upper limit may mitigate some of these consumer concerns of resuming functionality quickly from sleep mode. DOE also considered

other allowable transition times less than 30 seconds or more than 30 seconds. However, its view is that a transition time shorter than 30 seconds may be too restrictive for certain STB designs. Conversely, DOE believes a transition time greater than 30 seconds may discourage consumers from using sleep mode and would affect DOE's estimated usage profile for the calculation of AEC as discussed in section III.I.

DOE recognizes that imposing the 30 second requirement would not measure any sleep power saving techniques that may take longer than 30 seconds to resume functionality and may subsequently discourage power saving techniques in that area. On the other hand, excluding this requirement would essentially treat all low power sleep modes the same for the purposes of power measurement, regardless of whether or not the STB resumed functionality quickly. STBs that resume functionality more quickly could have higher consumer adoption and thus, more overall energy savings, which would not be captured if there were no requirement for resuming functionality. This is because, as indicated by AT&T's consumer studies and other public commenters, consumers are less likely to use the various sleep modes if it takes too long to resume functionality, , which would result in more STBs staying in on mode all day. Therefore, DOE is proposing the requirement that the STB shall transition to on mode within 30 seconds and requests stakeholders to comment on the proposed requirement.

DOE invites interested parties to comment, and provide data if available, on the proposed requirement of transitioning from sleep mode to on mode within 30 seconds or whether a different maximum allowable transition time should be considered.

Off mode: The STB is connected to a mains power source, has been de-activated, and is not providing any function. The STB requires a user action to transition from this mode to on or sleep mode.

The proposed definition for off mode is exactly as specified in the draft CEA-2043 standard. A STB that is de-activated does not provide any functions and a user action is required for the STB to provide any function. A user action means an action that would require the consumer to interact with the STB using either a single or a series of keystrokes or button presses, either on a remote control or on the STB unit. DOE understands that this is the generally accepted definition by industry for off mode.

E. Test Conditions

1. Set-top Box Settings

DOE received comments regarding the configuration in which the STB should be setup for testing. NCTA stated that STBs should be tested in “as-shipped” condition and as normally installed for an end-user. (NCTA, No. 0034 at p. 19) AT&T and CEA commented that in order to reduce the risk of stifling innovation, the STB test procedure rulemaking should require that newly introduced features be turned off to the extent possible. CEA commented similarly but further stated that turning off newly introduced features during testing could reduce the accuracy and utility of the test procedure. (AT&T, No. 0032 at p. 22) (CEA, No. 0031 at p. 5)

DOE proposes the following requirements for setting up the STB for testing. There are different requirements depending on whether the STB can be installed by the consumer using the user manual shipped with the unit or whether a technician is required to install the STB per the

manufacturer's instructions. These proposed requirements are included in section 3.1 (Set-top Box Settings) of the proposed Appendix AA to Subpart B of 10 CFR Part 430.

For all STBs that require subscription to a service, the simplest available video subscription that supports all functionality proposed in today's test procedure shall be selected for operating the STB. That is, subscriptions with TV services only shall be selected and packages with non-video capability, such as telephony, shall not be selected.

If the STB can be installed by the consumer per the manufacturer's instructions without the service of a technician, then it shall be installed and setup according to the user manual shipped with the unit. Only those instructions in the user manual should be used for setting up the STB and setup should be considered complete once they are followed.

If the STB must be installed by a technician per the manufacturer's instructions, then the unit shall be setup as installed by the technician for testing. All steps that a technician would follow when installing a STB for use in a consumer residence should be followed. DOE recognizes that for testing a STB in the setup in which it is installed in a consumer's home, a third-party test lab would require this setup information. Therefore, information about each of the steps that were performed to setup the STB by a technician shall be recorded and maintained by the manufacturer pursuant to 10 CFR Part 429.71 as part of the test data underlying the ratings.

The goal of DOE's proposed requirements for the STB settings is to ensure that the STB is tested under the same settings as it would be when installed in a consumer's home. This

proposal is similar to an older draft version of the CEA-2043 standard, which required STBs to be tested in the configuration in which it is supplied to consumers. DOE proposes to use the simplest available video subscription that supports all functionality proposed in today's test procedure for testing because, at a minimum, all STBs will provide these services. Testing all STBs with the simplest subscription ensures consistency across testing of the different STB models. Further, DOE believes that setting up the STB in the same configuration that the consumer would use the STB, ensures that the test is representative.

DOE requests comment on the proposed requirements for setting up the STB as installed in a consumer's home for testing.

In regards to comments made by AT&T and CEA about newly introduced features on STBs, DOE disagrees with commenters and is not proposing to turn off or disable any such features. DOE believes that turning off newly introduced features that are enabled as part of the typical set-up process would not be representative of the energy use the consumer would see once installed. Instead, it is more representative of the consumer's use to keep these features in the setting in which they are when first installed in a consumer's home per the manufacturer's instructions. DOE expects that most consumers typically do not change the settings of the STB after it is installed. That is, DOE believes the configuration in which the STB is installed by a technician is the configuration in which the STB is operated most commonly and, therefore, keeping non-tested features in these initial settings would capture the most representative energy consumption of the STB. This proposed requirement is consistent with requirement specified in section 8.1.9 of the draft CEA-2043 standard, which optionally specifies that non-tested product features may be left in the default condition.

2. Test Room

DOE proposes to specify ambient conditions for testing STBs that are similar to the requirements specified in section 7.3 of the draft CEA-2043 standard. DOE recognizes that the power consumption of the STB could vary with the ambient conditions of the room in which the STB is tested. Therefore, the ambient conditions shall be controlled to ensure that the power measurements are repeatable and reproducible. The test conditions specified in the draft CEA-2043 standard, proposed in this NOPR, ensure that the test results are repeatable, reliable, and consistent without significant test burden. These conditions are discussed in further detail below and are included in section 3.2 (Test Room) of the proposed Appendix AA to Subpart B of 10 CFR Part 430.

DOE proposes that testing shall be carried out in a test room where the ambient temperature is maintained at 23 degrees Celsius ($^{\circ}\text{C}$) $\pm 5^{\circ}\text{C}$. DOE's believes that 23 $^{\circ}\text{C}$ represents the temperature of a typical room in which a STB may be used; it is DOE's understanding that this is the temperature range in which most household appliances are typically tested. Further, a tolerance of 5 $^{\circ}\text{C}$ for the ambient temperature is achievable because temperature measurement instruments generally provide for a greater accuracy than 5 $^{\circ}\text{C}$ and DOE expects it would not be burdensome for test labs to climate control the test room to meet these requirements. Finally, the temperature requirement of 23 $^{\circ}\text{C} \pm 5^{\circ}\text{C}$ is the same as that specified in the ENERGY STAR specification, which requires that the ambient temperature should remain between 18 $^{\circ}\text{C}$ and 28 $^{\circ}\text{C}$, inclusive, throughout testing.

DOE further proposes that the test room shall be such that the air movement surrounding the STB shall be less than or equal to 0.5 meters per second (m/s), as required in the draft CEA-2043 standard. However, DOE understands that it may be difficult to maintain the required ambient temperature range at such a low air speed. This is because the heat generated from the STB may heat up the surrounding air, and at such a low air speed, the ambient temperature may exceed the required range. Since it is likely that the power consumption of a STB does not change significantly at moderately higher air speeds, the requirement specified in the draft CEA-2043 standard may be stringent in conjunction with the temperature requirements. DOE therefore requests comments and data, if available, on the proposed 0.5 m/s air movement requirement and whether this value should be relaxed to a higher value or removed altogether.

Finally, DOE proposes that the STB shall be tested on a thermally non-conductive surface, which is a requirement specified in the draft CEA-2043 standard. This requirement ensures that the internal temperature of the STB is maintained at a level consistent with a typical consumer setup, which usually does not have a thermally conductive surface. DOE requests comment on the proposed test room conditions for testing STBs, including the air temperature, air speed, and thermally non-conductive test surface requirements.

F. Test Setup

1. Test Voltage

DOE proposes that the input power requirements for testing STBs shall be as specified in section 7.4 of the draft CEA-2043 standard and are included in section 4.1 (Test Voltage) of the proposed Appendix AA to Subpart B of 10 CFR Part 430. These requirements state that an alternating current (AC) power source shall be used to power the STB with an input voltage of

115 volts (V) \pm 1 percent. Further, the frequency of the power source shall be 60 hertz (Hz) \pm 1 percent. The total harmonic distortion of the supply voltage when supplying power to the STB in the specified mode shall not exceed 2 percent, up to and including the 13th harmonic. Finally, the peak value of the test voltage shall be between 1.34 and 1.49 times its rms value; that is, the value of the crest factor shall be between 1.34 and 1.49. DOE's understanding is that the proposed requirements for input power are typical for testing consumer electronics and notes that this aligns with the requirements specified in the ENERGY STAR specification for qualifying STBs in the North American market. DOE invites interested parties to comment on the proposed input power requirements.

2. Measurement Accuracy

DOE proposes to specify the accuracy of power measurements similar to those required in section 7.2 of the draft CEA-2043 standard. These requirements are included in section 4.2 (Measurement Accuracy) of the proposed Appendix AA to Subpart B of 10 CFR Part 430. The draft CEA-2043 standard specifies that power measurements of 0.5 watt (W) or greater shall be made such that the uncertainty of the measurement is less than or equal to 2 percent at the 95 percent confidence level. For power measurements of less than 0.5 W, the uncertainty of the measurement shall be less than or equal to 0.01 W at the 95 percent confidence level. The resolution of the instrument used to measure power shall be 0.01 W or better for power measurements of 10 W or less, 0.1 W or better for power measurements greater than 10 W and up to 100 W, and 1 W or better for power measurements greater than 100 W. For equipment connected to more than one phase, the power measurement instrument shall be equipped to measure the total power of all phases that are connected. DOE's view is that these requirements are reasonable and generally accepted by industry for the accuracy of power measurements. The

uncertainty requirements are specified in IEC-62301²⁷, which is referenced by IEC-62087, and also match the requirements listed in the ENERGY STAR specification for testing STBs. DOE invites interested parties to comment on the proposed requirements for measurement accuracy.

3. Test Equipment

Section 7.5 of the draft CEA-2043 standard provides recommendations for equipment that may be used to monitor AC line current, voltage, and frequency. DOE proposes to include this recommended equipment that is optional for testing. The following recommended equipment are included in section 4.3 (Test Equipment) of the proposed Appendix AA to Subpart B of 10 CFR Part 430:

- 1) An oscilloscope with a current probe to monitor the AC line current waveform, amplitude, and frequency.
- 2) A true rms voltmeter to verify the voltage at the input of the STB; and
- 3) A frequency counter to verify the frequency at the input of the STB.

DOE's view is that these instruments would be appropriate to ensure that the current, voltage, and frequency measurements are accurate. DOE invites interested parties to comment on the recommended test equipment to measure the AC line current, voltage, and frequency.

4. True Power Wattmeter

²⁷ International Standard. "Household electrical appliances – Measurement of standby power." Edition 2.0 2011-01.

DOE proposes that the power meter attributes shall be as specified in section 7.5.2 of the draft CEA-2043 standard, which provides the crest factor, bandwidth, frequency response, and sampling interval requirements for the power wattmeter. Each of these attributes is discussed in section III.F.4.a through III.F.4.d below and are included in section 4.4 (True Power Wattmeter) of the proposed Appendix AA to Subpart B of 10 CFR Part 430. These requirements are necessary because electronic equipment can cause harmonics that lead to inaccurate power measurements. The proposed requirements are standard specifications for measuring power using a power wattmeter and are listed as the characteristics of approved meters in IEC-62301. Additionally, these requirements are specified in the ENERGY STAR specification for testing STBs. Due to widespread industry acceptance, DOE's view is that these requirements are reasonable and it should not be burdensome for stakeholders to meet these conditions. DOE invites interested parties to comment on the proposed power meter instrumentation requirements, such as the crest factor, bandwidth, frequency response requirements, and sampling interval.

a. Crest Factor

DOE proposes that the crest factor attributes shall be as specified in the draft CEA-2043 standard, which requires that the power wattmeter shall have an accuracy and resolution in accordance with that proposed in section III.F.2 of this NOPR and sufficient bandwidth. Additionally, the crest factor rating shall be appropriate for the waveforms that are measured, and it shall be capable of reading the available current waveform without clipping the waveform. Consistent with the draft CEA-2043 standard, DOE also proposes that the peak of the current waveform that is measured during the on and sleep modes of the STB shall be used to determine the crest factor rating and the current range setting. The full-scale value of the selected current

range multiplied by the crest factor for that range shall be at least 15 percent greater than the peak current to prevent measurement error.

b. Bandwidth

DOE proposes the following requirements as specified in the draft CEA-2043 standard. The current and voltage signal shall be analyzed to determine the highest frequency component (that is, harmonic) with a magnitude greater than 1 percent of the fundamental frequency under the test conditions. Additionally the minimum bandwidth of the test instruments shall be determined by the highest frequency component of the signal.

c. Frequency Response

As specified in the draft CEA-2043 standard, DOE proposes that a wattmeter with a frequency response of at least 3 kilo-hertz (kHz) shall be used in order to account for harmonics up to the 50th harmonic.

d. Sampling Interval

DOE proposes to adopt the sampling interval requirement as specified in the draft CEA-2043 standard. This requirement specifies that the wattmeter shall be capable of sampling at intervals less than or equal to 1 second.

5. Calibration

DOE proposes to specify test instrument calibration requirements that are identical to those required in section 7.5.1 the draft CEA-2043 standard. The draft CEA-2043 standard specifies that the testing equipment shall be calibrated annually to traceable national standards to

ensure that the limits of error in measurement are not greater than ± 0.5 percent of the measured value over the required bandwidth of the output. The annual calibration requirement proposed by DOE is typical for the equipment required for testing of all electrical products. The proposed calibration requirements are included in section 4.5 (Calibration) of the proposed Appendix AA to Subpart B of 10 CFR Part 430. DOE invites interested parties to comment on the proposed calibration requirements for testing STBs.

6. Network Setup

a. Home Network Connection

As specified in section 8.1.4 of the draft CEA-2043 standard, DOE proposes that for STBs that require the use of a home network, such as thin-client STBs, an HNI connection shall be used. Further, DOE proposes that the HNI connection shall be used in the following order of preference: MoCA, HPNA, Wi-Fi, or any other HNI connection. That is, if MoCA connection is available, the STB shall be tested using MoCA. If MoCA is not available, HPNA shall be used followed by Wi-Fi as the last option. These proposed requirements are consistent with the requirements listed in the ENERGY STAR specification and are sequenced based on most commonly used HNI connections to least commonly used HNI connections. These requirements are included in section 4.6.1 (Home Network Connection) of the proposed Appendix AA to Subpart B of 10 CFR Part 430. DOE invites interested parties to comment on the proposed requirements for testing STBs that require an HNI connection. DOE also requests comment about whether there are any additional HNI connections that should be included and the order of preference in which they should be included.

b. Broadband Service

DOE proposes to specify setup requirements for STBs requiring broadband service connections that are similar to the requirements stated in section 8.1.5 of the draft CEA-2043 standard. These requirements are included in section 4.6.2 (Broadband Service) of the proposed Appendix AA to Subpart B of 10 CFR Part 430. The draft CEA-2043 standard specifies that if the STB includes an HNI and the HNI shall be connected to broadband service for operation of a principal STB function, then it shall be tested while connected to a broadband network.

Broadband performance criteria, such as download speed, upload speed, and latency shall meet the specific requirements of the STB to fulfill the principal STB functions. DOE understands that certain STBs, such as IPTV STBs, require a broadband connection to provide the principal STB functions and is therefore proposing this requirement. DOE also proposes to include clarification that for STBs designed to operate both with a broadband connection and service provider network connection (as discussed in section III.F.6.e), the service provider connection takes precedence, and a broadband connection shall only be made if the STB requires it for operating a principal STB function. This clarification has been included because there may be some STBs that are able to provide service on both a broadband network as well as a service provider network. DOE's understanding is that STBs typically operate on the service provider network connection rather than the broadband connection, and thus, proposes to test with only the service provider connection unless a broadband connection is required. DOE requests comment on the proposed setup requirements for STBs requiring broadband service as well as the clarification that a service provider network connection takes precedence over a broadband connection for STBs that are designed to operate on either connection.

c. Service Provider Network Distribution Equipment

As specified in section 8.1.6 of the draft CEA-2043 standard, DOE proposes that for STBs that require the use of external equipment to connect the service provider network to the STB, the power consumption of the external equipment shall not be included with the power consumption of the STB itself. If such equipment is integrated into the STB in the future, the power consumption of the equipment shall be included in the power consumption of the STB. Such external equipment may include network gateways, network routers, network bridges, ONTs, wireless access points, media extenders, or any other device that is required for the distribution of a service provider network to the STB. DOE is excluding the power consumption of the external equipment because network distribution equipment does not meet the proposed definition of the STB. As discussed in section III.B of this NOPR, if DOE initiates a rulemaking for network equipment in the future, the external equipment required to connect the service provider network to the STB would likely be under the scope of that rulemaking. DOE invites interested parties to comment on the proposed exclusion of external equipment power consumption from the power consumption of the STB itself. These requirements are included in section 4.6.3 (Service Provider Network Distribution Equipment) of the proposed Appendix AA to Subpart B of 10 CFR Part 430. If stakeholders indicate that the power consumption of such external equipment should be included with the power consumption of the STB, DOE requests input on the test method and standard configuration that could be used to measure the power consumed.

d. Input Signal Equipment

As discussed in section III.B of this NOPR, DOE received several comments from stakeholders regarding the inclusion of specific types of input signal equipment, such as LNB

equipment, in the scope of this proposed rule. However, as explained in section III.B, DOE does not believe input signal equipment meets the definition of STB as proposed in this NOPR because of significant operational differences from STBs. There is no standard configuration for the number of STBs that can be connected to any single input signal equipment. For example, for a certain household an LNB may be connected to three STBs and a different household may require two LNBs to connect three STBs. This lack of standardization does not allow a direct comparison between the different STBs that are connected to these equipment and therefore DOE does not propose to test input signal equipment while testing STBs.

Instead, DOE proposes to adopt the specifications stated in section 8.1.7 of the draft CEA-2043 standard with some modification. DOE proposes that when an ODU, over the air (OTA) antenna amplifier, cable TV (CATV) distribution amplifier, or similar signal equipment is required to operate the STB, the measurement shall not include the power consumption of this equipment, if it can be powered from a source other than the STB. If the signal equipment cannot be powered from a different source, then the power for these equipment shall be included in the STB power consumption measurement, and the signal equipment should be configured in its lowest power consuming mode. However, if the equipment is powered from a source other than the STB, it shall be powered from another source, and the signal equipment shall not deliver any power to the connected STB.

DOE's proposed specification is slightly different from that in the draft CEA-2043 standard. DOE proposes to include the requirement that if the input signal equipment cannot be powered from a source other than the STB, then it shall be powered from the STB and the power supplied to these equipment shall be included in the STB power consumption measurement.

Further, DOE proposes to include the additional clarification that the signal equipment should not deliver any power to the STB, if the equipment is powered from a different source, to avoid the possibility of circumvention. This would occur if the power consumption of the STB is rated lower than the actual consumption of the STB because a separately powered device, the input signal equipment, provides the additional power required to operate the STB. DOE also considered requiring the use of a direct current (DC) block in order to prevent power transfer to and from any such input signal equipment; however, DOE has not proposed this requirement because the DC block could potentially impact the functionality of such input signal equipment. These requirements are included in section 4.6.4 (Input Signal Equipment) of the proposed Appendix AA to Subpart B of 10 CFR Part 430.

DOE requests comment on the proposed exclusion of the power consumption of the input signal equipment from the power consumption of the STB and the additional clarification that such equipment should not supply power to the STB. DOE also requests feedback on the potential use of a DC block to prevent power transfer to and from any input signal equipment. Further, if stakeholders indicate that such equipment should be tested and the power consumption be measured as part of this proposed rule, DOE requests comment on the test method and standard configuration that could be used to test this equipment.

e. Service Provider Network Connection

DOE received some comments from NRDC and CA IOUs about testing STBs on a live network or closed network. NRDC commented that STBs should be tested as they are deployed in the field with “live” head-end equipment. (NRDC, No. 0017 at p. 4) Further the CA IOUs commented that while testing performed on a live network would result in real power

consumption, it also may be impractical. They further stated that if testing was performed during a period of a large software update, the power consumption of the STB may be elevated and atypical. Additionally, it may take longer measurement periods to yield repeatable results on the live network. (CA IOUs, No. 0033 at p. 7) Finally, DISH, EchoStar, and DIRECTV commented that the energy consumption of a satellite STB on a live network is generally not affected by geography, location, time of day, or subscription package, which are possible sources of variation when using a live network. (DISH, EchoStar, DIRECTV, No. 0030 at p. 11)

Based on its review of the comments received, the practicality of testing a STB on a live network compared to a closed network, and a review of CEA's requirements in the draft CEA-2043 standard, DOE proposes to adopt the same requirements listed in section 8.1.8 of the draft CEA-2043 standard. These requirements allow either a live network or closed network to be used for testing and provide specific requirements for both. The draft CEA-2043 standard specifies that the STB shall be tested with a specific service provider network or a simulated environment that is verified by the service provider, and the STB shall be configured to simulate a subscriber operating environment. This shall include the ability to access the full services of the service provider network required by the STB. These services include content, program guides, software updates, and other STB features that require network services to function completely. If the STB requires a POD or Smart Card, then it shall be connected, authorized, and operational. Essential peripheral devices that are required for the normal operation of the STB, such as a Universal Serial Bus (USB) powered external HDD, a USB powered Wi-Fi dongle, or a USB powered OTA receiver, shall be connected and operational during testing. Optional peripheral devices shall not be connected to the STB.

For testing the STB in a laboratory environment, DOE proposes to adopt the specification in the draft CEA-2043 standard, which states that the STB may be tested in a laboratory environment containing control equipment comparable to a live service provider system. For a cable STB, this would require a laboratory that contains a conditional access system, the appropriate equipment to communicate with the STB (such as ANSI/SCTE 55-1²⁸ or ANSI/SCTE 55-2²⁹ forward and reverse data channel hardware or data-over-cable service interface specification (DOCSIS) infrastructure), and the appropriate interconnections (such as diplexers, splitters, and coaxial cables). DOE proposes to incorporate by reference, in 10 CFR Part 430.3, the industry standards ANSI/SCTE 55-1 and ANSI/SCTE 55-2 to describe the equipment required to communicate with the STB when testing in a laboratory environment.

These requirements are included in section 4.6.5 (Service Provider Network Connection) of the proposed Appendix AA to Subpart B of 10 CFR Part 430. DOE invites interested parties to comment on the proposed requirements for service provider network connection. Particularly, DOE requests comment and data, if available, about whether the power consumption of a given STB is similar when it is operated on a live network versus a closed network.

G. Test Method and Measurements

1. Set-top Box Warm-up

The first step in measuring the power consumption of the STB after setting up the test room and equipment is to connect the STB and operate it for a certain period of time until it

²⁸ Society of Cable Telecommunications Engineers. Engineering Committee. Digital Video Subcommittee. “Digital Broadband Delivery System: Out of Band Transport Part 1: Mode A.” American National Standard.

²⁹ Society of Cable Telecommunications Engineers. Engineering Committee. Digital Video Subcommittee. “Digital Broadband Delivery System: Out of Band Transport Part 2: Mode B.” American National Standard.

reaches a stable condition. It is important to warm-up, or stabilize, the STB so that the measured values of power consumption are not fluctuating dramatically, and a repeatable measurement can be taken. To stabilize the STB, DOE proposes to adopt the requirement specified in section 8.1.1(e) of the draft CEA-2043 standard. The standard requires the STB be operated in on mode (as discussed in section III.G.5 of this NOPR) while receiving and decoding video for at least 15 minutes for the STB to achieve stable condition. DOE expects that 15 minutes should be sufficient to warm-up the STB. This warm-up is also consistent with the ENERGY STAR test method. The STB warm-up requirements are specified in section 5.1 (Set-top Box Warm-up) of the proposed Appendix AA to Subpart B of 10 CFR Part 430. DOE invites interested parties to comment on the proposed warm-up time for stabilizing the STB.

2. Test Configuration Information

To test the STB in on, sleep, and off modes, DOE proposes to specify the configuration in which the STB shall be connected with one or more display devices and clients. This information is not specified in the draft CEA-2043 standard; instead section 8.1.11 of the standard states that the entity specifying the use of the CEA standard is expected to provide this information. Because DOE is proposing to adopt the requirements specified in the draft CEA-2043 standard, DOE qualifies as the entity specifying the use of the CEA standard. Accordingly, DOE proposes to specify this information, as discussed in the following paragraphs. The proposed test configuration information is included in section 5.2 (Test Configuration Information) of the proposed Appendix AA to Subpart B of 10 CFR Part 430.

The draft CEA-2043 standard requires the following information to be specified: a configuration diagram of the STBs, clients, display devices, and any other devices required for

testing; the specific network technology to be used for each test, if applicable; the maximum number of connected display devices and clients for each test, if applicable; devices in the network configuration that cannot be tested; required tests to be run on each device; and, test parameters for each required test.

Accordingly, DOE proposes to specify that the test configuration described in Table 1 shall be used to configure all STBs and connected devices. Because it is possible to configure STBs in several different ways, DOE is proposing a table that lists the priority in which STBs shall be configured rather than providing several different configuration diagrams to cover the various possibilities. For multi-streaming STBs, the proposed configuration in Table 1 describes the number of display devices and clients that shall be connected to the STB depending on its capabilities. If a STB is not capable of multi-streaming, that is, if the STB cannot connect to multiple display devices and does not support DVR and clients, then it shall be connected to only one display device according to the proposed configuration in the last row of Table 1. Each STB type is expected to fall in one of the rows of Table 1 only. For example, a STB with DVR capability that supports connections to multiple display devices and clients shall be connected to one display device and one client according to the configuration proposed in the first row of Table 1. DOE developed the proposed configuration table such that a maximum of three different content streams are enabled for multi-streaming STBs for the multi-stream test, which is discussed in section III.G.5.b.

Table 1: Display Device and Client Connection Setup.

Supports Multiple Display Devices?	Supports DVR?	Supports Clients?	Number of Connected Display Devices	Number of Connected Clients
-------------------------------------------	----------------------	--------------------------	--------------------------------------------	------------------------------------

X	X	X	1	1
X	X		2	0
X		X	2	1
	X	X	1	1
X			2 or 3*	0
	X		1	0
		X	1	1 or 2*
			1	0

* The highest number of connections supported by the STB shall be used.

DOE further proposes that the same test configuration shall be used throughout testing in the on, sleep, and off modes of operation for all STBs. The draft CEA-2043 standard also requires DOE to propose the maximum number of display devices and clients that shall be connected to the STB. Because the number of connections depends on the configuration that is feasible from Table 1, DOE is not proposing the maximum number of connections. Instead, DOE proposes to use as many connections as required for the configuration that is feasible from Table 1. For example, a STB that can be connected to multiple display devices and a client, but does not have DVR capability, shall be connected to two display devices and one client throughout testing.

DOE proposes that the connection type that is used to connect the display device to the STB shall be selected in the following order of preference. The first preference shall be to connect a display device to the STB using an HDMI connection, followed by Component Video, S-Video, and Composite Video, respectively. If none of these connections are available or feasible, then any other video interface that is feasible shall be used. The order of preference for connecting display devices to the STB is adopted from the comments received from stakeholders in response to the TVs test procedure rulemaking. 77 FR 2830, 2839-2840 (January 19, 2012).

Sharp commented that video input to a TV should be selected in the following order: HDMI, Component Video, S-Video, and Composite Video. (EERE-2010-BT-TP-0026, Sharp, No. 45 at p. 6) Mitsubishi Electric Visual Solutions America (MEVSA) suggested the following input hierarchy definition: "Testing shall be performed using a HDMI input. If the TV does not have an HDMI input, the following inputs shall be used in the following order: component, S-Video, and composite. If the TV has none of these inputs, an appropriate interface shall be used." (EERE-2010-BT-TP-0026, MEVSA, No. 44 at p. 3)

Additionally, DOE proposes that the connection type that is used to connect the client to the STB shall be an HNI connection. The order of preference in which an HNI connection shall be selected is discussed in section III.F.6.a of this NOPR.

Finally, the draft CEA-2043 standard provides that the entity specifying the use of the CEA-2043 standard (which is DOE in this case) is expected to specify the required tests to be run on each device and the test parameters for each required test. DOE proposes these test specifications in the on, sleep, and off modes in sections III.G.5 to III.G.7 of the NOPR.

DOE invites interested parties to comment on all aspects of the proposed configuration for testing STBs in the on, sleep, and off modes of operation. DOE is especially interested in receiving comments on the proposed connections for the test configuration. DOE also invites comments on the proposed order of preference for connecting a display device to the STB.

3. Test Conduct

DOE proposes to specify the type of content that shall be streamed to each device that is connected to the STB according to the configuration discussed in section III.G.2 above. The information about the streaming content is included in section 5.3 (Test Conduct) of the proposed Appendix AA to Subpart B of 10 CFR Part 430. While the connections required for the STB configuration during testing shall remain the same throughout testing, the number and type of test streams that shall be enabled for the various tests are proposed to be different. This is similar to the usage expected in a typical household that has all display devices and clients connected to the STB at all times, but the number of streams enabled to each connected device is different depending on the number of active viewers on different display devices at a given point of time. When multiple streams are enabled to output connect to a display device, record on a DVR that is integrated into the STB, or stream content to a connected client, DOE proposes that the content streamed to each shall be different. That is, the content outputted to a display device for viewing a channel shall be different from the content recorded on a DVR, which shall also be different from the content streamed to a connected client. DOE is proposing this requirement because DOE believes consumers generally view and record different content simultaneously. Further, DOE proposes the following specifications for the content stream that is used for streaming to a display device, DVR, and client.

a. Output to a Display Device

For tests requiring output to be sent to a display device(s), DOE proposes that a channel shall be selected and viewed on the connected display device(s) as required by the test configuration. If the STB does not support channels, an appropriate SD or HD test stream shall be selected and viewed on the display device(s). If more than one display device is connected to

the STB based on the test configuration that is feasible, then the content outputted on each display device shall be different.

DOE's proposed requirements for providing video output to a display device have been adopted from the draft CEA-2043 standard, which specifies that a channel, if supported, or other appropriate content, shall be sent to a connected display device. DOE additionally proposes that if multiple display devices are connected to the STB, then the content on each display device shall be different. This requirement has been specified because DOE believes it mirrors typical user operation wherein if two TVs are operating in a household at the same time, most of the time the content being viewed would be different. DOE requests comment on the proposed requirements for providing video output to a display device.

b. Recording for a STB with DVR capability

For tests that require recording on a STB with DVR capability, DOE proposes that a channel shall be selected using a connected display device or a client and the program shall be recorded. If more than one recording is required on a DVR that is integrated into the STB, the content for each recording shall be different.

DOE is proposing to test the record functionality of STBs with DVR capability because it believes that this is one of the most commonly used features of such a STB. The proposed method to record the content on a DVR that is integrated into the STB is adopted from the draft CEA-2043 standard's on (record) – DVR STB test. Similar to its proposal in section III.G.3.a above for outputting content to a display device, DOE is proposing that different content be recorded on a DVR integrated into the STB if more than one recording is enabled. This is

because it is unlikely that users would record the same programming simultaneously. DOE invites comment on the proposed requirements to record on a DVR integrated into the STB.

c. Streaming to a Connected Client

DOE proposes that the content streamed to a client shall be selected in the following order of preference depending on the number of streams enabled. The first available stream that is supported by each connected client shall be enabled and the content on each stream shall be different. The first preference shall be to use a stream with recorded content to stream to the client. That is, content that has been recorded previously shall be streamed to the client and viewed on a display device connected to the client. If the client does not support streaming of recorded content, then a stream with channel content shall be used. That is, a channel shall be viewed on the display device connected to the client. An SD test stream shall be viewed if it is an SD client and an HD test stream shall be viewed if it is an HD client. For clients that do not support channels, an appropriate SD or HD test stream shall be selected and viewed. Finally, if the client does not support either a recorded stream or a channel stream, then any other stream that is supported by the client shall be used.

DOE believes that by proposing a hierarchy for the selection of streams for the connected client(s), there will be consistency and repeatability between tests without imposing an undue burden on manufacturers. DOE selected the proposed hierarchy based on the most power consumptive option to the least power consumption option. The power consumed by a STB when streaming recorded content, which requires the HDD to operate as well, is expected to be higher compared to when streaming a channel. This proposed hierarchy would ensure consistency in the results by accounting for the power differences.

DOE's proposed specification for playing back recorded content or streaming a channel to the connected client is adopted from the requirements specified in the draft CEA-2043 standard's on (play) – DVR STB test and on (watch TV) test, respectively. DOE requests comment on the proposed requirements to stream to a connected client. Specifically, DOE requests comment on the proposed hierarchy of content to stream to a connected client.

4. Calculation of Average Power Consumption

For all tests in the on, sleep, and off modes (NOPR sections III.G.5, III.G.6, and III.G.7, respectively), DOE proposes that the average power consumption shall be calculated using one of two methods. The two proposed methods are included in section 5.4 (Calculation of Average and Rated Power Consumption) of the proposed Appendix AA to Subpart B of 10 CFR Part 430.

The first method is as specified in section 8.2.1 and 8.3.1 of the draft CEA-2043 standard. The standard specifies that the accumulated energy (E_i) in kWh consumed over a period of time (T_i) shall be recorded and the average power consumption (P_i) is calculated as the quotient of the accumulated energy over the time period, that is, $P_i = E_i/T_i$. DOE proposes to adopt this specification from the draft CEA-2043 standard to determine the average power consumption and, in addition, proposes a second method to calculate average power.

The second method proposed by DOE allows for the average of multiple power samples at a rate of at least 1 sample per second. The average power value is calculated by taking the arithmetic mean of all the power samples over a period of time. This type of measurement is typical of many laboratory setups that perform AC power measurements and therefore DOE is

proposing to allow this method in addition to the accumulated energy consumption method above.

For both methods, DOE is proposing an average power measurement rather than an instantaneous measurement. This is consistent with comments from CA IOUs, who are in favor of using an average power consumption value rather than an instantaneous one. Specifically, the CA IOUs commented that if testing is performed during a period of a large software update, the power consumption of the STB could be elevated and atypical. (CA IOUs, No. 0033 at p. 7) DOE believes an average measurement would average out any elevated power consumption.

DOE is proposing an average measurement of power consumption based on comments received from CA IOUs and DOE's internal testing results. DOE tested eight STB models during internal testing using both HD and SD test streams, for a total of 16 tests in the on, sleep, and off modes of operation. The STBs that were tested included two STBs with DVR functionality, two STBs without DVR functionality, and four over-the-top (OTT) STBs. DOE also performed one repeatability test each on three STBs using the HD test stream. The power meter that was used during internal testing provided the accumulated energy consumption over time (the first proposed method) as well as the average power consumption values sampled over time (the second proposed method). The average power consumption using both methods was the same. DOE sampled the power consumption values over a duration of 10 minutes at the rate of one sample per second. That is, DOE collected data that provided the instantaneous power consumption at any point of time over the 10 minute duration as well as the average power consumption over different time periods (example: 2 minutes, 5 minutes, etc.). Figure 1 below compares the instantaneous power versus the 2 minute and 5 minute average power in the on

mode for a STB that DOE tested internally. The power consumption values have been normalized to the total average power over the 10 minute test duration.

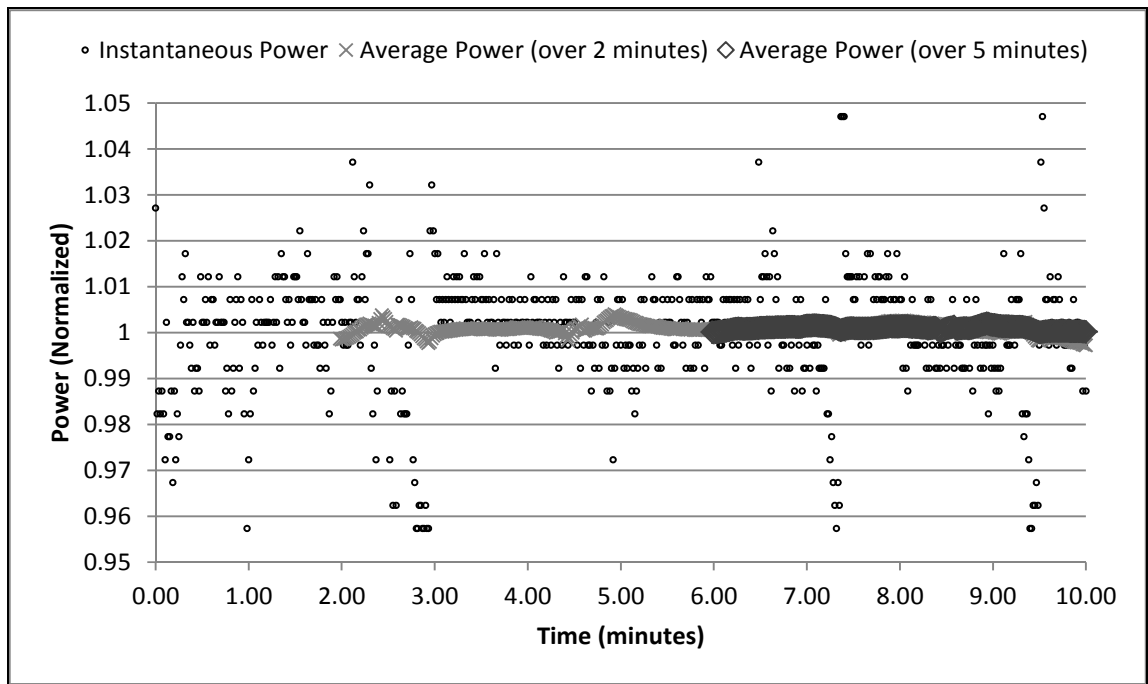


Figure 1: Data from DOE's Internal Testing for Average versus Instantaneous Power Consumption for a STB

Figure 1 indicates that an average value over 2 minutes and 5 minutes for the on mode test provided a more stable and repeatable measurement compared to the instantaneous measurement. This result is expected for STBs given the different activities that are performed from time to time, such as maintenance or software updates. If the power is measured at a particular instant, there is a possibility that the recorded value may be too high or too low depending on the content being streamed at that time. Further, for the sleep mode tests which require the power consumption to be determined over 4 to 8 hours, an average measurement could capture the potential decrease in power consumption if the STB powered down into lower power modes, depending on the time when the measurement is taken. DOE's proposed average

power measurement is consistent with the requirements specified in section 8.6.5 of the IEC 62087 standard as well.

DOE requests comment on the proposed methods to determine the average power consumption of the STB in each mode of operation.

5. On Mode Power Measurement

For on mode testing, DOE proposes two tests: an on (watch TV) test and a multi-stream test, which combines the multiple principal STB functions into a single test. Rather than testing each individual principal STB function separately, which may be burdensome to test, DOE is proposing to use these two tests to best represent typical STB usage. This would simplify testing as well as allow for different STBs to be operated under different conditions. The on (watch TV) test evaluates the power consumption of the STB when utilizing the most basic function that all STBs share in common, watching a channel outputted on a display device from a STB. The multi-stream test evaluates the power consumption of the STB when multiple principal STB functions are used simultaneously.

DOE further proposes that the time period for each test in the on mode, T_{ON} , shall be 2 minutes. The draft CEA-2043 standard from which DOE's proposed on mode test procedure is derived, does not specify the duration of time the STB shall be operated for the on mode test; instead, in section 8.1.11 it states that the entity specifying the use of the CEA-2043 standard (which is DOE in this case) shall specify the time period. Therefore, DOE is proposing that the duration of the test shall be 2 minutes, which is consistent with the time period specified in section 8.6.5 of IEC 62087 for the on mode tests. Additionally, as shown in Figure 1 in section

III.G.4 of the NOPR, results from internal testing conducted by DOE indicated that the average power consumption over 2 minutes was sufficient to provide repeatable results. That is, the 2 minute moving average over a 10 minute test duration showed less variability compared to the instantaneous power measurements. Additionally, the average power consumption of the STB over 2 minutes was similar to the average power consumption of the STB over 5 minutes during internal testing as seen in Figure 1 in section III.G.4 of the NOPR.

DOE invites comment on all aspects of the proposed approach for testing the STB in the on mode of operation.

a. On (Watch TV) Testing

DOE proposes to adopt the on (watch TV) test procedure specified in section 8.2.2.1 of the draft CEA-2043 standard with some modification. First, the STB shall be configured as proposed in Table 1 in section III.G.2 of the NOPR. The STB shall be configured such that all devices for the feasible configuration are connected to the STB. Of all the connections to the STB, only one stream shall be enabled and shall stream to a connected display device. All other connected display devices and clients shall not have any content streamed to them. Next, an SD channel shall be selected and viewed on the connected display device. If the STB uses a content provider that does not support channels, an appropriate SD test stream shall be selected and viewed on the display device. Finally, the power consumption measurement shall be started and the average power consumption shall be recorded for 2 minutes as $P_{\text{WATCH_SD}}$. For STBs that support HD streaming, the test shall be repeated using HD content and the average power shall

be recorded for 2 minutes as P_{WATCH_HD} . The average power consumed in the on (watch TV) mode, P_{WATCH} , shall be calculated using the following equation:

$$P_{WATCH} = \begin{cases} \frac{P_{WATCH_SD} + P_{WATCH_HD}}{2}, & \text{STB supports HD} \\ P_{WATCH_SD}, & \text{STB doesn't support HD} \end{cases}$$

DOE's proposed method for testing in the on (watch TV) mode is included in section 5.5.2 (On (Watch TV)) of the proposed Appendix AA to Subpart B of 10 CFR Part 430. DOE's proposed test method is different from that specified in the draft CEA-2043 standard in one key area. The draft CEA-2043 standard tests an HD STB using an HD test stream only; DOE's proposed approach tests an HD STB for 2 minutes using an SD test stream, followed by 2 minutes of testing using an HD test stream. DOE proposes to use both the SD and HD test streams to test HD STBs because it does not expect all content to be available on an HD stream in the near future. That is, DOE's expectation is that HD STBs may continue to stream some content using an SD stream because the content would not be available in an HD broadcast stream. Therefore, testing an HD STB using both an SD and HD test stream would represent the typical use of an HD STB better than testing it on an HD stream only. This requirement is also specified in the ENERGY STAR specification, and it allows stakeholders the opportunity to represent energy savings if a STB can be designed to consume less energy while streaming SD content compared to streaming HD content. DOE expects this additional test will have minimal impact on testing burden.

Further, DOE proposes that for HD enabled STBs, the average power in on (watch TV) mode shall be the average of the average power consumed using an SD stream and HD stream.

DOE also considered whether different weights, other than the average, should be used to combine the power consumption using SD and HD streams for an HD STB that is representative of consumers' usage of each of these streams. However, DOE does not have any data that indicates the percentage of streams that are available only in SD for HD STBs.

DOE requests comment on the proposed method to test the on (watch TV) principal STB function. DOE also requests interested parties to comment, and provide data if available, on the percentage of streams that are available in SD and HD for HD STBs, and whether the proposed equation for calculating P_{WATCH} should be changed.

b. Multi-stream Testing

To test other principal STB functions that are capable of multi-streaming as defined in section III.D.4 of the NOPR, DOE proposes a multi-stream test that simultaneously tests the most common STB functions such as, viewing a channel, recording, and playback. The proposed multi-stream test is included in section 5.5.3 (Multi-stream) of the proposed Appendix AA to Subpart B of 10 CFR Part 430. DOE proposes to test the power consumption of STBs that are capable of multi-streaming as follows: First, the STB shall be configured as proposed in Table 1 in section III.G.2 of the NOPR. The STB shall be configured such that all devices required for the feasible configuration are connected to the STB. Next, the number of streams that shall be enabled and the type of content that shall be streamed using the STB shall be as specified in Table 2 of the NOPR. The highest priority (smallest number in column 1 of Table 2) of streaming content that is supported by the STB shall be selected. All streams required for the supported priority shall be enabled using appropriate content as described in section III.G.3 of the NOPR. As an example, if the STB does not have DVR capability but can connect to multiple

display devices and clients, priority 3 shall be selected and the STB shall output different content to two display devices and shall playback previously recorded content on a connected client.

Table 2: Priority List for the Multi-stream Test.

Priority for Enabling Multi-streaming - 1 is highest priority - 9 is lowest priority	Number of Streams Enabled:		
	To Display Devices	To Record on DVR	To Connect to Clients
1	1	1	1
2	2	1	-
3	2	-	1
4	1	2	-
5	1	-	2
6	3	-	-
7	1	1	-
8	1	-	1
9	2	-	-

If the STB or connected client supports HD streaming, an HD test stream shall be used, otherwise an SD stream shall be used. Finally, the multi-stream mode power consumption measurement shall be started and the average power consumed by the STB shall be recorded for 2 minutes as P_{MULTI_STREAM} .

The multi-stream test proposed by DOE to test multiple functionalities of the STB simultaneously, is not explicitly specified in the draft CEA-2043 standard, but the standard contains most of the information that DOE has combined for the multi-stream test. The standard specifies the methods to test the play (section 8.2.2.2 of the standard) and record (section 8.2.2.3 of the standard) functionality of STBs with DVR capability, it provides recommendations for concurrent testing of networked STBs, and the different tests that may be performed on different

types of STBs. However, the draft CEA-2043 standard does not require any of these tests and states that the entity specifying the use of the draft CEA-2043 standard (which is DOE in this case) shall provide the specific configuration and type of tests to be performed. Therefore, DOE is proposing the multi-stream test, which specifies that: (1) the STB shall be setup according to the configuration in Table 1 in section III.G.2 of the NOPR; and, (2) different functionalities that are to be tested shall be enabled using the priority listed in Table 2. Once the STB is setup and the different functionalities are enabled, the power consumption of the STB in multi-stream shall be measured. To develop this proposed multi-stream test for power consumption measurement, DOE has adopted the draft CEA-2043 standard's play and record tests.

DOE's view is that the proposed multi-stream test is representative of typical consumer usage of a STB compared to individually testing the different STB features. That is, DOE expects that users would operate multiple, different functions of the STB at the same time rather than operate each function in sequence.

Further, for STBs that are capable of multi-streaming, DOE is proposing that a maximum of three streams shall be enabled, if feasible. If the STB supports only two streams, then two streams shall be enabled. DOE is proposing to enable a maximum of three streams because, according to data published by The Nielsen Company in January 2011, the average number of TVs per US household is 2.5.³⁰ Based on this data, DOE approximated that a typical household in the US has up to three TVs and DOE assumed that a STB would typically be performing up to three functions at a time. Therefore, DOE is proposing that a maximum of three streams are

³⁰ Nielsen Wire. "Factsheet: The U.S. Media Universe".
<http://blog.nielsen.com/nielsenwire/online_mobile/factsheet-the-u-s-media-universe/>

enabled. While there may be STBs that are capable of streaming more than three different content streams at a time, attempting to test all available streams would result in testing the STB at an extreme condition and would not be representative of typical STB usage. DOE, however, is considering implementing a maximum power test in which the STB is tested at maximum functionality where the maximum number of streams is exercised simultaneously. DOE is not currently proposing such a test, but requests feedback on including a maximum streaming test, and if included, also requests comment on the weightings that should be applied to the AEC calculation (discussed in further detail in section III.I).

DOE invites interested parties to comment on the proposed test procedure for testing STBs with multi-streaming capability. DOE is especially interested in receiving comments on the proposed priority list for enabling streams for testing STBs with multi-streaming capability. DOE also seeks feedback on whether the number of additional streams that should be enabled should be other than three and the reasons for enabling a different number of streams. DOE requests comment on the possibility of including a maximum power test, which would test the STB such that the maximum number streams are enabled. If included, DOE requests comment on the weighting that should be applied for the maximum streaming test in the calculation of the AEC.

6. Sleep Mode Power Measurement

For sleep mode testing, DOE proposes two tests only for those STBs that are capable of transitioning from sleep mode to on mode within 30 seconds as defined in section III.D.5 of this NOPR. If the STB cannot be placed in sleep mode, DOE proposes that this test be skipped. For manufacturers that wish to determine whether a given basic model contains a sleep mode that

meets the 30 second transition time requirement, DOE is proposing that the sleep to on mode transition time test should be performed as described in section III.G.8 of the NOPR. While this test is not necessary for determining the power consumption values in the three modes, DOE would perform this tests to determine how the sleep mode consumption should be determined.

The two sleep mode tests are: a manual sleep test in which the STB enters sleep mode through a user action, and an APD test in which the STB automatically enters sleep mode after a period of user inaction. The proposed sleep mode test is included in section 5.6 (Sleep Mode Power Measurement) of the proposed Appendix AA to Subpart B of 10 CFR Part 430.

DOE further proposes that the time period for each test in the sleep mode, T_{SLEEP} , shall be at least 4 hours and up to a maximum of 8 hours. The time period shall be extended beyond 8 hours if a network initiated action occurs which requires the sleep mode test to be performed for a longer duration (discussed below in further detail). Similar to the on mode test, section 8.1.11 of the draft CEA-2043 standard specifies that the entity specifying the use of the CEA-2043 standard (which is DOE in this case) shall provide the time period. Therefore, DOE is proposing that the power consumption be determined over 4 to 8 hours. The proposed time duration for the sleep mode tests is much longer than the 2 minutes proposed for the on mode tests because DOE expects that many STBs may transition to lower power consumption modes after being in sleep mode for a couple of hours. Testing over a duration of 4 to 8 hours shall capture the decreased power consumption if it occurs within the 4 to 8 hour time period.

DOE considered other options for the time period over which the average power of the STB in sleep mode should be measured, such as more than 8 hours, only 8 hours, only 4 hours,

or less than 4 hours. DOE did not pursue the option of testing sleep mode over a period greater than 8 hours because of the large testing burden associated with such a long duration. DOE also considered a value less than 4 hours but is concerned that a STB may not power down to the lowest possible energy consumption mode in less than 4 hours. DOE is proposing between 4 to 8 hours for testing the STB because it is the half (4 hours) to full (8 hours) duration of an expected over-night sleep mode of a STB, assuming an 8 hour over-night duration during which most consumers are not using the STB. Further, DOE expects that if a STB has the capability to power down to lower sleep modes, it would do so within 4 to 8 hours.

For both, the manual sleep test and APD test, DOE proposes that certain conditions be ensured while the STB is in sleep mode. That is, it shall be ensured that no recording events are scheduled over the entire duration of the test, including the time the STB is in on mode prior to transitioning to sleep mode. Further, if a STB is capable of scheduling a recording, a recording shall be scheduled 24 or more hours into the future.

Next, no service provider network initiated action (such as, content downloads or software updates) requiring a transition to on mode shall occur over the 4 to 8 hours that the STB is in sleep mode. If a service provider network initiated activity cannot be disabled, then this requirement shall be monitored by sampling the power consumption at a rate of at least 1 sample per second over the entire duration of the test and observing the changes to the power consumption over time. If the input power is less than or equal to 1 W, then a linear regression through all power readings shall have a slope of less than 10 mill-watts per hour (mW/h). If the slope of the linear regression is equal to or greater than 10 mW/h, it is assumed that a network activity has occurred and the test shall either be restarted or extended until the slope is less than

10 mW/h. For input powers greater than 1 W, a linear regression through all power readings shall have a slope of less than 1 percent of the measured input power per hour. If the slope is equal to or greater than 1 percent, it is assumed a network activity has occurred and the test shall either be restarted or extended until the slope is less than 1 percent. In addition, if the test is extended beyond 8 hours to meet the required conditions, the average power consumption over the entire test duration shall be used to calculate the rated power consumption in sleep mode.

Finally, no local area network initiated actions requiring a transition to on mode shall be scheduled over the 4 to 8 hours that the STB is in sleep mode (example: mobile applications or other network devices requesting service).

The above requirements for sleep mode testing have been adopted from the draft CEA-2043 specification with some differences. For example, section 8.3.1 of the draft CEA-2043 standard specifies that no recording shall be scheduled while the STB is in sleep mode. However, DOE proposes that no recording shall be scheduled for the entire duration that the STB is tested for the sleep mode test, including the time the STB is in on mode prior to transitioning to sleep mode. For the manual sleep test, the time period in on mode is 5 minutes (as discussed in section III.G.6.a of the NOPR) and for the APD test, this time period is a maximum of 4 hours (as discussed in section III.G.6.b of the NOPR). This proposed requirement enables the STB to transition to sleep mode as desired, without any scheduled recordings keeping the STB in on mode.

DOE is also proposing, for sleep mode testing, that a recording be scheduled 24 or more hours into the future on STBs that are capable of scheduling a recording. This proposed

requirement is not part of the draft CEA-2043 standard. DOE has included the recording requirement because it understands that the power consumption of the STB may be different when a recording is scheduled compared to when it is not. When a recording is scheduled, the STB performs some non-primary functions in the background to keep track of time and ensure that it transitions to on mode once it is time to initiate recording. On the other hand, if the STB does not have any recording or other functions scheduled for the future, it may not perform any function until the user transitions it back to the on mode using a remote control. DOE expects that a STB in a consumer's home typically keeps track of some command that requires it to initiate an action in the future while it is still in sleep mode. For example, while the STB is in sleep mode it may have to transition to on mode because the user had scheduled a recording prior to placing it in sleep mode. Therefore, DOE proposes that a recording shall be initiated 24 or more hours into the future from test time.

Another difference between DOE's proposed test method and the requirements specified in the draft CEA-2043 standard is that section 8.3.1 of the standard specifies that it shall be ensured that no service provider network initiated actions occur while the STB is in sleep mode. However, for STBs that may not be tested by a manufacturer and are tested at a third-party laboratory, it might not be possible to know when a service provider network initiated action occurs. Because it is not possible to control the initiation of this activity, DOE is proposing that the power readings recorded at a rate of at least 1 sample per second shall be observed for changes in power consumption and a linear regression shall be performed to determine whether a service provider initiated activity has occurred. As discussed above, if the slope of the linear regression is greater than 1 percent, for input powers greater than 1 W, then it is assumed a network initiated action occurs and the test shall be restarted or extended until the slope is less

than 1 percent. The proposed requirements for analyzing the power consumption readings have been adopted from the IEC 62301 standard with some modification. IEC 62301 specifies similar requirements for determining the power consumption within a mode that is not cyclic. A potential drawback of DOE's proposed method to check for a network initiated action is that if the slope of the linear regression is analyzed and used to gauge for network initiated activities, it is possible that the slope may vary even when the STB transitions to lower power consumption modes through the sleep mode. That is, if a STB enters sleep mode when the "Power" button on the remote is pressed, and then continues to transition to lower power consumption modes over the 4 to 8 hour time period of the sleep mode test, then the slope of the linear regression may not be less than 1 percent of the measured input power per hour as specified in the requirements. In such a scenario, the test duration for the sleep mode may be extended until the power consumption of the STB stabilizes around a particular value. While this would increase the test burden for manufacturers and third-party laboratory testing, an advantage would be that the lowest power consumption modes of the STB would be captured and included in the sleep mode power consumption measurements. Alternatively, DOE is concerned that if the time period of the sleep mode test is extended to be much longer than 8 hours, the test may increase test burden.

DOE also considered other options to monitor for network initiated activities, which it has not proposed in today's rulemaking. One of these options would be to sample the power consumption at a rate of at least 1 sample per second and determine if the power samples continuously exceed the median power consumption by more than 10 percent of the median power for more than 15 minutes over the 4 to 8 hour sleep mode duration. However, DOE did not propose this approach for several reasons. First, any value that is selected for comparing the power samples to the median power (such as 10 percent in the setup discussed here) as well as

the duration of time (15 minutes) may not encompass all possible scenarios of a transition from sleep to on mode during the sleep mode test. For example, if a network event increases power by 5 percent over a duration of 2 hours, this approach would not capture the transition from sleep to on mode even though the increase in power consumption would be significant. Another disadvantage of this approach is that periodic events that may be intended to occur during sleep mode would be falsely captured as a network initiated activity. For example, if a STB wakes up for 15 minutes every 2 hours while in sleep mode, this approach would capture it as a network event, while in fact it is a scheduled activity that should be part of the sleep mode power consumption measurement.

Another approach that DOE considered but has not proposed would be to test the STB in sleep mode for a very long period of time, such as 24 hours, so that the effect of a network initiated activity is mitigated over the long time period. However, DOE determined not to propose this approach because of the significant test burden to testing laboratories.

Finally, once all the conditions for performing the sleep mode test are met, DOE proposes that the STB shall be configured as proposed in Table 1 in section III.G.2 of the NOPR. The STB shall be configured such that all devices required for the feasible configuration are connected to the STB. Once the STB is configured it shall be placed into sleep mode as described in section III.G.6.a for the manual sleep test and as described in section III.G.6.b for the APD test.

DOE invites comment on all aspects of the proposed specification for setting up STBs for testing in the sleep mode of operation. In particular, DOE is interested in receiving comments on the proposed time duration of 4 to 8 hours over which the power consumption shall be measured

and whether this duration should be increased or decreased to better represent STB power consumption in sleep mode. DOE also requests comment on the proposed scheduled recording requirement prior to placing the STB in sleep mode to measure its power consumption. DOE requests interested parties to provide data, if available, on the variation in power consumption of a STB when a recording is scheduled versus when it is not. Finally, DOE invites interested parties to comment on all aspects of the proposed method to address network initiated actions. DOE requests comment and data, if available, on the approach proposed in today's NOPR, the approaches that were considered but have not been proposed, as well as any other approach that stakeholders believe would best capture the transition of the STB from sleep mode to on mode due to network initiated activities.

a. Manual Sleep Testing

DOE proposes to measure the STB power consumption in the manual sleep mode only for STBs that can transition from sleep mode to on mode within 30 seconds as defined in section III.D.5 of the NOPR. For STBs that cannot support sleep mode, DOE proposes that the power consumption in manual sleep mode, $P_{\text{SLEEP_MANUAL}}$, shall be set equal to P_{WATCH} . For STBs that support sleep mode, DOE proposes to measure the STB power consumption in manual sleep mode as follows. Once the STB is configured it shall be operated in the multi-stream test configuration (section III.G.5.b of the NOPR) for at least 5 minutes, if the STB supports multi-streaming. If the STB does not support multi-streaming, it shall be operated in the on (watch TV) configuration (section III.G.5.a of the NOPR) for at least 5 minutes. Next, the "Power" button on the remote for the STB and each locally connected display device and client shall be pressed momentarily (for less than 1 second) to place the STB and each locally connected display device and client into sleep mode, as defined in section III.D.5 of the NOPR. The STB remote control

shall not be used (or moved) after the STB has been placed in sleep mode. It must be ensured that the STB and each locally connected client has entered sleep mode. This shall be done by ensuring no channel viewing or recording is supported on the STB and clients. That is, there shall be no video output on the connected display device(s) from the STB and any locally connected clients. The manual sleep mode power consumption measurement shall be started and the average power consumed by the STB shall be recorded as $P_{\text{SLEEP_MANUAL}}$ over the time period as determined in section III.G.6 of the NOPR. DOE's proposed test for the manual sleep mode is included in section 5.6.7 (Manual Sleep Test) of the proposed Appendix AA to Subpart B of 10 CFR Part 430.

DOE is proposing to set $P_{\text{SLEEP_MANUAL}}$ equal to P_{WATCH} for STBs that may not necessarily support the manual sleep mode test. This is because assigning a value of 0 kWh for the power consumption in manual sleep mode for such STBs would be misleading. A 0 kWh power consumption value in manual sleep mode may indicate that the STB does not consume any energy when it is placed in sleep mode, which is inaccurate. Further, for the purposes of the calculation of the AEC metric (discussed in detail in section III.I of the NOPR), setting $P_{\text{SLEEP_MANUAL}}$ equal to P_{WATCH} would count the STB as being in the on mode if it does not support the manual sleep mode test. This would ensure that the AEC metric is a representation of STB operation that is consistent with the definition of sleep mode proposed in this NOPR.

DOE's proposed test procedure for determining the average power consumed by the STB in manual sleep mode is similar to the requirements specified in section 8.3.4 of the draft CEA-2043 standard for the sleep mode test procedure, with some minor differences. While DOE proposes that the STB shall operate in on mode for at least 5 minutes prior to placing the STB in

sleep mode, the draft CEA-2043 standard does not specify any time requirement. DOE is proposing this requirement to ensure that all STBs that are tested are operated for the same duration of time prior to transitioning to sleep mode. DOE selected 5 minutes as the minimum proposed duration to operate the STB in on mode prior to placing it in sleep mode to ensure that the STB is fully functional before sleep mode is initiated, without increasing the test burden significantly. During internal testing (described in section III.G.4 of the NOPR), DOE observed that none of the tested STBs took longer than 5 minutes to turn on and enable functionality. DOE believes this requirement will ensure that there is consistency and repeatability between tests without imposing an undue burden on manufacturers.

Another difference between DOE's proposed test and the draft CEA-2043 standard is that the standard provides three different methods to verify that the STB has entered sleep mode and specifies that any of the three methods can be used for verification. These are: ensuring that no channel viewing or recording is supported on the STB; observing a sleep mode indicator on the STB, which may be found from the user manual; or, waiting for a predetermined period of time that is provided by the entity specifying the use of the CEA-2043 standard. Of these methods, DOE is proposing to use the first approach, which requires ensuring that no channel viewing or recording is supported on the STB. DOE expects this method to be the most common way for determining whether or not a STB has entered sleep mode. Not all STBs have a sleep mode indicator on the box and a standard predetermined wait time for all STBs could potentially be long or short for at least some of the STBs. An individual check on each STB guarantees that the STB has transitioned to sleep and that the measurement may be taken.

DOE invites interested parties to comment on the proposed requirements for testing STBs in manual sleep mode.

b. Auto Power Down Testing

DOE proposes to perform an APD test as a second sleep mode test. The APD test is included in section 5.6.8 (Auto Power Down (APD) Test) of the proposed Appendix AA to Subpart B of 10 CFR Part 430. To measure the power consumption of a STB that is capable of APD, DOE proposes the following test. Similar to the manual sleep test, once the STB is configured it shall be operated in the multi-stream test configuration (section III.G.5.b of the NOPR) for at least 5 minutes, if the STB supports multi-streaming. If the STB does not support multi-streaming, it shall be operated in the on (watch TV) configuration (section III.G.5.a of the NPR) for at least 5 minutes. Next, the “Power” button on the remote shall be pressed momentarily (for less than 1 second) only for any locally connected clients to place the connected clients into sleep mode, as defined in section III.D.5 of the NOPR. Additionally, if more than one display device is locally connected to the STB, the “Power” button on the remote for the additional locally connected display devices shall be pressed and the STB shall stream content to one connected display device only. Once all but one connected display device are “off”, the STB remote control shall not be used. The STB shall be operated until it enters sleep mode or until 4 hours elapse, whichever occurs first. If the STB does not transition into sleep mode at the end of 4 hours, then the STB is not considered to support APD and $P_{\text{SLEEP_APD}}$ shall be set equal to P_{WATCH} . Once the STB is in APD, the power consumption measurement in APD shall be started and the average power shall be recorded as $P_{\text{SLEEP_APD}}$ over the time period as determined in section III.G.6 of the NOPR.

DOE's proposed test is similar to the manual sleep test discussed in section III.G.6.a of the NOPR; the only difference is that in the manual sleep mode test the STB is placed into sleep mode manually, while in the APD test the STB transitions to sleep mode because no user activity occurs over a certain time period. DOE's proposed test for APD also has some differences from the power mode transition – “on to APD” transition test described in section 8.5.1 of the draft CEA-2043 standard. First, the test specified in the draft CEA-2043 standard records both the power consumption to transition from on mode to APD and the time it takes to transition from on mode to APD. In DOE's proposed test procedure, however, DOE proposes a maximum time of 4 hours for the STB to transition to sleep mode through APD. DOE proposes that the STB should transition to sleep mode within 4 hours, or else the STB is not considered to support APD. DOE's proposed 4 hour time limit to transition to APD is adopted from the ENERGY STAR specification, which states that products that offer the APD feature should be shipped with APD enabled by default and with the APD timing set to engage after a period of inactivity less than or equal to 4 hours.

DOE considers the 4 hour time limit to be reasonable because it assumes that TV programming typically does not exceed 4 hours in duration. Therefore, if a viewer is watching such programming without sending any other commands to the STB over the duration of the program, the STB may transition to APD at the end of 4 hours without shutting off the viewer's program of interest. DOE also considered allowing the STB configuration to be changed from its default APD behavior to a shorter period for the purposes of testing APD as long as the default behavior was to power down within 4 hours. This would shorten the test time for the APD test; however, DOE does not propose this approach at this time as it may not be clear as to whether or not the default behavior meets the required 4 hour limit without exercising the test. DOE also

considered a period less than 4 hours for the APD test, but preliminarily determined that any mandated time period that is shorter may have a negative impact on the consumer, because it may transition the STB to sleep mode while the consumer may still be viewing the programming.

DOE also considered scaling the APD, wherein the power consumption in APD would be dependent on the duration required for the STB to transition from on mode to sleep mode using the APD feature. For example, DOE currently proposes to assign 7 hours to the APD power consumption value while calculating the AEC metric as discussed in detail in section III.I of the NOPR. The proposed method to calculate AEC allocates these 7 hours to APD assuming it would require 4 hours to transition from on mode to sleep mode using the APD feature. DOE also considered allowing for a higher daily hour allocation for STBs that entered APD within 1 or 2 hours. However, DOE is concerned that proposing scaling of power consumption in APD in the test procedure may encourage manufacturers to use a very short default APD time period that might be intrusive to the consumer experience. This would hamper consumer adoption of APD because the STB may transition to sleep mode while a consumer is still viewing content. In such a situation, if the consumer disables the APD feature, the potential energy savings for APD enabled STBs may not be realized in the field. While DOE is not proposing a scaled APD power consumption value in today's NOPR, it requests stakeholders to comment on potential methods to scale APD and the advantages and disadvantages of scaling the power consumption in APD. DOE also requests comment on the impact of a scaling APD power consumption value on the proposed AEC metric (discussed in section III.I of the NOPR) and potential methods to account for a scaling APD value in the AEC metric.

Another difference between DOE's proposed test for APD and the test specified in the draft CEA-2043 standard is that DOE proposes the same configuration of connections for the STB as is used for all other tests. In contrast, the test specified in the draft CEA-2043 standard tests on an individual STB only. As discussed in section III.G.3 of the NOPR, DOE's proposed method matches the usage expected in a typical household. That is, all connected devices will be connected to the STB at all times, but the STB will be performing different functions at different times. Therefore, DOE has not changed the configuration in which the STB is tested for the APD test.

DOE invites interested parties to comment on the proposed test for determining the STB power consumption in APD. Particularly, DOE requests comment and data, if available, on the time required to transition to sleep mode and whether this time period should be set at a default value of 4 hours or adjusted during testing.

7. Off Mode Power Measurement

DOE's proposed test procedure for determining the power consumption of a STB in off mode is similar to the test procedure specified in section 8.4.1 of the draft CEA-2043 standard. The proposed off mode test is included in section 5.7 (Off Mode Power Measurement) of the proposed Appendix AA to Subpart B of 10 CFR Part 430. DOE proposes the following test to determine the off mode power consumption of the STB. If the STB supports off mode as defined in section III.D.5 of the NOPR, it shall be placed in off mode. If it does not support off mode as defined in section III.D.5, this test shall be skipped. Next, wait until the STB enters off mode and record the average power consumed by the STB for 2 minutes as P_{OFF} .

DOE invites interested parties to comment on the proposed requirements for testing STBs in off mode.

8. Sleep to On Mode Transition Time Measurement

DOE proposes to include a test to verify the time required to transition from sleep mode to on mode to help manufacturers to determine if the basic model contains a sleep mode per DOE's proposed regulatory definition (discussed in section III.D.5 of the NOPR). According to the definition proposed for sleep mode in section III.D.5 of the NOPR, a STB is considered to be in sleep mode only if it can transition from sleep mode to on mode within 30 seconds. While STB manufacturers may know the time it takes for the STB to transition, DOE is including this test in today's proposed test procedure in the event there is any uncertainty if the STB meets the sleep mode requirements. The proposed test procedure for determining the transition time from sleep mode to on mode is described below and has been adopted from section 8.5.5 of the draft CEA-2043 standard's Power Mode Transition – "Sleep to On" Transition test method. The proposed sleep to on mode transition time measurement test is included in section 5.8 (Sleep to On Mode Transition Time Measurement) of the proposed Appendix AA to Subpart B of 10 CFR Part 430.

DOE proposes the following test to determine the sleep to on mode transition time. The test shall be used to verify two different cases. First, to determine the transition time from sleep to on mode for the manual sleep test, and second, to determine the transition time from sleep to on mode for the APD test. For the manual sleep test, the STB shall be placed into sleep mode according to the steps specified in the manual sleep mode test (described in section III.G.6.a of the NOPR). For the APD test, the STB shall be allowed to transition to sleep mode from on

mode automatically, according to the steps specified in the APD test (described in section III.G.6.b of the NOPR). For both sleep mode tests, once the STB enters sleep mode, wait until the STB power consumption (P_{SLEEP} , which is generic for $P_{\text{SLEEP_MANUAL}}$ or $P_{\text{SLEEP_APD}}$) is between P_{SLEEP} and $P_{\text{SLEEP}} + 0.5\text{W}$. That is, the power consumption should be less than $P_{\text{SLEEP}} + 0.5\text{ W}$ and greater than P_{SLEEP} . After the power consumption reaches the desired value, wait for at least 5 minutes before pressing the “Power” button on the remote or front panel of the STB. Once the STB is powered, elapsed time measurement shall be started and the duration shall be measured until the STB enters on mode. It shall be ensured that the STB has entered on mode when it supports channel viewing on the connected display device or client. The duration to transition from sleep mode to on mode shall be recorded as $T_{\text{SLEEP_TO_ON}}$. If $T_{\text{SLEEP_TO_ON}}$ is greater than 30 seconds then $P_{\text{SLEEP_MANUAL}}$ and/or $P_{\text{SLEEP_APD}}$ shall be set equal to P_{WATCH} .

DOE’s proposed test to determine the transition time from sleep mode to on mode is similar to the sleep to on mode transition test specified in the draft CEA-2043 standard, with some additional specifications. First, DOE’s proposed test specifies that the STB shall be placed into sleep mode in two different ways; manually using the STB remote for the manual sleep test, and automatically for the APD test as described in section III.G.6.b of the NOPR. DOE has included this requirement to ensure that the STB is placed into sleep mode according to both sleep mode tests proposed in this NOPR. Next, the draft CEA-2043 standard does not explicitly specify the amount of time a STB should be kept in sleep mode, but states that it should be for the predetermined stabilization time. Therefore, DOE is proposing that the STB shall remain in sleep mode for at least 5 minutes to stabilize the STB in sleep mode. DOE believes that 5 minutes is a sufficient period of time to ensure the STB has completed any remaining operations.

For the sleep to on mode transition time measurement test, DOE also proposes that if $T_{\text{SLEEP_TO_ON}}$ is greater than 30 seconds, then $P_{\text{SLEEP_MANUAL}}$ shall be set equal to P_{WATCH} and $P_{\text{SLEEP_APD}}$ shall also be set equal to P_{WATCH} . DOE has included this requirement because if the transition time is greater than 30 seconds, then the STB will not meet the sleep mode definition described in section III.D.5 of the NOPR and will therefore, not be considered in sleep mode.

DOE requests comment on the proposed sleep to on mode transition time measurement test.

H. Sampling Plan

DOE is proposing the following sampling plan and rounding requirements for STBs to enable manufacturers to make representations of power consumption in the on, sleep, and off modes of operation. The represented power consumption values shall be used to calculate the AEC metric (discussed in section III.I of the NOPR), which shall be rounded according to the requirements proposed below. The sampling requirements are included in the proposed section 429.55 of Subpart B of 10 CFR Part 429.

DOE is proposing to keep the minimum sample size of STBs that shall be tested to determine rated power consumption at two, as defined in 10 CFR Part 429.11. However, manufacturers may choose to test a greater number of samples of a given basic model, if desired. Additionally, DOE is proposing that the rated value of power consumption in the on, sleep, and off modes of operation of a basic STB model for which consumers would favor lower power consumption values shall be greater than or equal to the higher of the mean of the sample or the

95 percent UCL of the true mean divided by 1.05. The equations below show the calculation of the mean and the UCL, respectively.

The mean of the sample is calculated as follows:

$$\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i$$

Where:

\bar{x} = the sample mean,

n = the number of samples, and

x_i = the i^{th} sample.

The UCL is calculated as follows:

$$UCL = \bar{x} + t_{0.95} \left(\frac{s}{\sqrt{n}} \right)$$

Where:

\bar{x} = the sample mean,

s = the sample standard deviation,

n = the number of samples, and

$t_{0.95}$ = the t statistic for a 95 percent one-tailed confidence interval with $n-1$ degrees of freedom.

Based on internal testing DOE conducted on STBs (described in section III.G.4 of the NOPR), DOE expects that the proposed test procedure can provide repeatability within 2 percent. Thus, DOE proposes to divide the UCL value by 1.05. In the case where the two samples differ by 2 percent, the UCL value will be 6 percent greater than the mean, and dividing by 1.05 would result in a value that is only 1 percent greater than the mean. Larger variances in samples would result in greater UCL values as dictated by the 95 percent confidence interval. DOE invites interested parties to comment on the proposed sampling plan.

DOE proposes that only the mean and the UCL of the samples tested shall be rounded, while all calculations to determine the mean and UCL shall be performed with unrounded values. For making representations using the power consumption values in each mode of operation, DOE proposes that the accuracy requirements discussed in section III.F.2 of the NOPR shall be used as rounding requirements. The proposed rounding requirements for the rated power consumption values are included in section 5.4 (Calculation of Average and Rated Power Consumption) of the proposed Appendix AA to Subpart B of 10 CFR Part 430.

Once the rated power consumption values for the on, sleep, and off modes are calculated and rounded, DOE proposes that these rated values shall be used to calculate the AEC metric, which is discussed in section III.I of the NOPR. For the rounding requirements of the AEC

metric from the rated power consumption values, DOE proposes the following: if the AEC is 100 kWh or less, the value shall be rounded to the nearest tenth of a kWh. If the AEC is greater than 100 kWh, the value shall be rounded to the nearest kWh. The proposed rounding requirements for the AEC metric are also based on the accuracy requirements discussed in section III.F.2 of the NOPR. The proposed rounding requirements for the AEC metric are included in section 6 (Calculation of the Annual Energy Consumption of the Set-top Box) of the proposed Appendix AA to Subpart B of 10 CFR Part 430.

DOE requests comment on the proposed rounding requirements for representing the power consumption in each mode of operation and the rounding requirements for the AEC metric, which is calculated from the rated power consumption values.

I. Method to Calculate the Energy Consumption of a Set-top Box

DOE received several comments about the metric that should be used to determine the annual energy consumption of a STB. CA IOUs commented that while typical energy consumption (TEC) calculation is common practice for rulemakings, it would not work for STBs because these products do not fit the mold for typically regulated products. (CA IOUs, No. 0033 at p. 3) Instead, they suggested a metric that would focus on sleep power levels. In contrast, AT&T commented that consistency with the ENERGY STAR testing methodology was desirable, particularly because regulation is being layered onto an already-existing voluntary program. (AT&T, No. 0032 at p. 28) AT&T further commented that the user profile should reasonably reflect the current usage patterns of their customers. (*Id.*) Finally, Cisco commented that the user profiles cannot be the only metrics considered by DOE for establishing STB testing and standards. Cisco commented that STBs are not manufactured based on the average usage

profile, but on outlier consumer usage and worst case scenarios addressing decoding, multiple streams, maximal DVR usage, etc. (Cisco Systems, Inc., No. 0027 at p. 31)

Based on the comments received and analyzing the current STB market, DOE proposes that individual power consumption values in each mode of operation and an annualized energy metric, the AEC metric, shall be the metrics from today's proposed test procedure. That is, the power consumption in on mode (P_{WATCH} and $P_{\text{MULTI_STREAM}}$), sleep mode ($P_{\text{SLEEP_MANUAL}}$ and $P_{\text{SLEEP_APD}}$), and off mode (P_{OFF}), and the AEC metric are the results of the proposed test procedure.

The average power consumption in each mode of operation is determined as described in sections III.G.5 through III.G.7 of the NOPR. Once the individual average power consumption values are determined, the rated power consumption in each mode of operation is calculated using the sampling plan and statistics discussed in section III.H. The rated power consumption in each mode of operation is then rounded according to the rounding requirements which are also discussed in section III.H. Finally, the AEC metric shall be calculated as a weighted average of the rounded, rated power consumption values, based on the expected time spent by the STB in the respective mode. DOE believes including both the individual power consumption metrics and an annualized metric provides both voluntary and State programs with the flexibility they may wish to run their respective programs. However, DOE reiterates that all representations of STB energy use must be made in accordance with one of these four metrics resulting from the DOE test procedure and sampling plan and as required by applicable State and federal law.

While the draft CEA-2043 standard describes how to measure the power in each mode of operation for a STB, it does not offer a way to combine the values into a single AEC metric. Therefore, to create a metric, DOE studied the ENERGY STAR test method for STBs. DOE believes the TEC metric used by ENERGY STAR is conceptually similar to the AEC metric that DOE is proposing in today's NOPR.

TEC is defined by ENERGY STAR as, “a means for evaluating energy efficiency through a calculation of expected energy consumption for a typical user over a 1 year period, expressed in units of kilo-watt hours per year (kWh/year)”. The TEC metric uses a table of time coefficients to weight individual power measurements that are obtained under the proposed test procedure. DOE proposes to use the same approach, and to name the metric AEC. Like TEC, the AEC metric will produce values measured in kWh/year. The equation below presents this approach mathematically. Power values (P_i) are the rated values obtained from the proposed measurement tests for each mode of STB operation as discussed in sections III.G.5 through III.G.7 of the NOPR and calculated using the sampling plan and rounding requirements discussed in section III.H of the NOPR. Further, DOE proposes that the time coefficients (H_i) shall be obtained from a table according to the type of STB being tested, and the mode of STB operation.

$$AEC = 0.365 \times \sum_{i=1}^n P_i \times H_i$$

Where:

i = the mode of operation.

The main modes of operation measured by the proposed measurement tests are:

P_{WATCH} = the rated power consumption (in W) in on (watch TV) mode,

P_{MULTI_STREAM} = the rated power consumption (in W) in the multi-stream test in on mode,

P_{SLEEP_MANUAL} = the rated power consumption (in W) in the manual sleep test in sleep mode,

P_{SLEEP_APD} = the rated power consumption (in W) in the APD test in sleep mode, for STB's with APD capability, and

P_{OFF} = the rated power consumption (in W) in off mode.

Inserting each of these modes into the above equation, results in the equation below for AEC.

$$AEC = 0.365 \times (P_{WATCH} \times H_{WATCH} + P_{MULTI_STREAM} \times H_{MULTI_STREAM} + P_{SLEEP_MANUAL} \times H_{SLEEP_MANUAL} + P_{SLEEP_APD} \times H_{SLEEP_APD} + P_{OFF} \times H_{OFF})$$

To determine the time coefficients, DOE evaluated the ENERGY STAR specification time coefficients as a possible source for the usage weightings. Table 3 below lists the ENERGY STAR usage weightings. For the sake of simplicity, the table excludes the ENERGY STAR weightings for deep sleep, which DOE is not proposing to adopt. DOE does not propose to adopt the ENERGY STAR deep sleep weightings because it believes that the proposed power consumption in sleep mode would capture the STB's deep sleep power as well, for any STBs that have deep sleep capabilities. This is because DOE's proposed time period for the sleep mode test is 4 to 8 hours, compared to ENERGY STAR's time period of 5 minutes.

Table 3: ENERGY STAR Weightings.

APD Enabled by Default	DVR?	T_{TV}	T_{SLEEP}	T_{APD}	H_{RECORD}	H_{PLAYBACK}
NO	NO	14	10	0	0	0
YES	NO	7	10	7	0	0
NO	YES	9	10	0	3	2
YES	YES	2	10	7	3	2

The values in the ENERGY STAR specification do not directly map to the modes DOE is proposing to test. In particular, there are no separate record and playback tests in DOE's proposed test procedure because these are bundled into a single multi-stream test as discussed in section III.G.5.b of this NOPR. However, DOE is proposing to adopt the ENERGY STAR weightings with the following changes: the 3 hour record time is combined with the 2 hour playback time into a single 5 hour multi-stream test. Further, the ENERGY STAR specification does not test the STB in off mode, and therefore does not assign any weighting to the STB power consumption in off mode. While DOE is proposing a test procedure to test the STB in off mode, it is not proposing any weighting to the STB power consumption in off mode because consumers typically do not turn off STBs. This is because often a STB cannot be turned off. Further, for STBs that can be turned off, the time required to start up a STB from off mode is lengthy and this discourages consumer adoption to turn-off the STB. Table 4 describes the weightings DOE is proposing to use, which have been developed from the ENERGY STAR weightings.

Table 4: DOE Proposed Hour Weightings.

APD Enabled by Default?	Multi- stream?	H_{WATCH}	H_{MULTI STR EAM}	H_{SLEEP MA NUAL}	H_{SLEEP_APD}	H_{OFF}
NO	NO	14	0	10	0	0
YES	NO	7	0	10	7	0
NO	YES	9	5	10	0	0
YES	YES	2	5	10	7	0

While DOE is proposing the hour weightings listed in Table 4 above, it also considered an alternative approach to estimate the time coefficients for each mode by researching STB usage profiles. The time coefficients from STB usage profiles is discussed in the following paragraphs and presented in Table 5, but is not proposed in today's NOPR. DOE is including this discussion to obtain stakeholders' feedback on the different possibilities to determine the hour weightings and the preferred approach that should be used for the calculation of AEC.

To determine STB usage profiles, DOE researched publically available usage data. According to the most recent publically available data from the Nielson Company, Americans spent 146.75 hours per month, or approximately 5 hours per day, watching TV in the home.³¹ DOE interpreted this to mean that the average STB spends 5 hours per day in the on (watch TV)

³¹ State of the Media: U.S. Digital Consumer Report, Q3-Q4 2011, The Nielson Company, p. 5.

mode. DOE determined the number of hours a STB may be in sleep mode by referring to survey data from Fraunhofer USA developed for CEA. The survey indicates that 60 percent of STBs are turned “off” in tandem with the TV, while 40 percent are left on and run continuously.³² Because a STB enters sleep mode when the power button on the remote is pressed to turn it “off”, DOE assumes that the 60 percent value refers to the number of STBs that are placed in sleep mode. DOE estimates that the average STB spends virtually no time in off mode.

Using these data, DOE assumed that for STBs without APD or multi-streaming capability, 40 percent remain in the on mode 24 hours per day. The remaining 60 percent spend 5 hours in on mode, and 19 hours in sleep mode. Time spent in APD and multi-streaming is zero. Therefore, the average STB that does not have APD or multi-streaming capability, is in on (watch TV) mode approximately 13 hours per day (40 percent x 24 hours + 60 percent x 5 hours) and sleep mode 11 hours per day (40 percent x 0 hours + 60 percent x 19 hours).

DOE researched market data from The Nielson Company and found that STBs with DVR capability spend approximately 5 hours viewing live programming and approximately 2 hours recording content and playing it back. For STBs with multi-streaming functionality, DOE assumed that of the 5 hours that are spent viewing live programming, at least 3 hours are viewed on a display device that is connected to a client. That is, at least 3 hours of TV programming is viewed through the multi-streaming functionality of the STB. While DOE does not have any market data that describes the number of hours a STB streams content to a client because multi-streaming is new functionality, it assumed that an increasing amount of content shall be viewed

³² Energy Consumption of Consumer Electronics in U.S. Homes in 2010, Fraunhofer USA, December 2011, p. 88. DOE’s understanding is that survey respondents interpreted the words “off” as a colloquialism for sleep mode.

through a client as the technology progresses. Summing the 2 hours for recording and playing back content with the 3 hours for viewing a channel through a client, DOE assumed that the multi-streaming functionality of a STB is exercised approximately 5 hours per day and the on (watch TV) functionality is exercised approximately 2 hours per day. Therefore, for STBs with multi-streaming functionality, but no APD functionality, DOE assumed that an average STB spends approximately 9 hours per day in on (watch TV) mode (40 percent x 19 hours per day + 60 percent x 2 hours per day); 5 hours per day in multi-streaming functionality; and 10 hours per day in sleep mode (40 percent x 0 hours per day + 60 percent x 17 hours per day).

To determine the number of hours a STB with APD functionality would spend in APD, DOE assumed that users that place their STB into sleep mode manually when not being used do not get any benefit from APD. APD functionality is only triggered if the STB is left in on mode for a long period of time. DOE has assumed that, for STBs that would otherwise be left in on mode all day, the presence of APD implied that the STB enters sleep mode via APD for 12 hours per day. DOE does not have data on the actual amount of time a STB is in sleep mode via APD and requests stakeholders to submit data, if available. The assumption of 12 hours per day is an estimate based on the expectation that the STB is likely to enter sleep mode via APD during times of light TV use, such as overnight and/or during mid-day. Based on these assumptions, the average STB that has APD but not multi-streaming capabilities is in APD approximately 5 hours per day (40 percent x 12 hours + 60 percent x 0 hours). Thus, DOE expects that STBs that enable APD by default would be in sleep via APD 5 hours per day instead of being in the on (watch TV) mode.

Finally, for STBs that are capable of both multi-streaming and APD functionality and are placed into sleep mode, DOE again assumed that the STB spends 5 hours per day in multi-streaming functionality and 2 hours per day in on (watch TV) mode. For STBs that always remain in on mode, DOE assumed that the total time spent in APD is 10 hours. This assumption is made based on the previous assumption that a STB that is not capable of multi-streaming spends a total of 12 hours per day in APD. That is, for STBs that are not placed into sleep mode manually, the viewer watches content on a TV for approximately 5 hours per day and of the remaining 19 hours, the STB spends approximately 12 hours per day in APD. Therefore, for a STB that has multi-streaming functionality, the viewer watches, records, or plays back content for approximately 7 hours per day and of the remaining 17 hours, the STB spends approximately 10 hours per day in APD. For STBs that are not placed into sleep mode, the remaining 9 hours per day are spent in on (watch TV) mode. That is, DOE assumed that an average STB spends approximately 5 hours per day in on (watch TV) mode (40 percent x 9 hours per day + 60 percent x 2 hours per day); approximately 10 hours per day in sleep mode (40 percent x 0 hours per day + 60 percent x 17 hours per day); approximately 5 hours in multi-streaming functionality; and, approximately 4 hours per day in APD (40 percent x 10 hours per day + 60 percent x 0 hours per day).

The resulting estimates for time coefficients are presented in Table 5 below as alternative weightings to the proposed AEC metric.

Table 5: Alternative Hour Weightings.

APD Enabled by	Multi- stream?	H_{WATCH}	H_{MULTI STR EAM}	H_{SLEEP MA NUAL}	H_{SLEEP_APD}	H_{OFF}

Default?						
NO	NO	13	0	11	0	0
YES	NO	8	0	11	5	0
NO	YES	9	5	10	0	0
YES	YES	5	5	10	4	0

DOE has proposed the hour weightings based on the ENERGY STAR specification (Table 4) in today’s NOPR and requests comment on the proposed weightings and calculation of AEC. DOE also requests comment on the alternative hour weightings (Table 5) that were developed by researching STB usage profiles. In particular, DOE seeks feedback on the time coefficients for AEC and whether one approach is preferred over the other. The proposed AEC calculation is included in section 6 (Calculation of the Annual Energy Consumption of the Set-top Box) of the proposed Appendix AA to Subpart B of 10 CFR Part 430).

IV. Procedural Issues and Regulatory Review

A. Review Under Executive Order 12866

The Office of Management and Budget has determined that test procedure rulemakings do not constitute “significant regulatory actions” under section 3(f) of Executive Order 12866, Regulatory Planning and Review, 58 FR 51735 (Oct. 4, 1993). Accordingly, this action was not subject to review under the Executive Order by the Office of Information and Regulatory Affairs (OIRA) in the Office of Management and Budget (OMB).

B. Review under the Regulatory Flexibility Act

The Regulatory Flexibility Act (5 U.S.C. 601 et seq.) requires preparation of an initial regulatory flexibility analysis (IRFA) for any rule that by law must be proposed for public comment, unless the agency certifies that the rule, if promulgated, will not have a significant economic impact on a substantial number of small entities. As required by Executive Order 13272, “Proper Consideration of Small Entities in Agency Rulemaking,” 67 FR 53461 (August 16, 2002), DOE published procedures and policies on February 19, 2003, to ensure that the potential impacts of its rules on small entities are properly considered during the DOE rulemaking process. 68 FR 7990. DOE has made its procedures and policies available on the Office of the General Counsel’s website: <http://energy.gov/gc/office-general-counsel>.

DOE reviewed today’s proposed rule under the provisions of the Regulatory Flexibility Act (RFA) and the policies and procedures published on February 19, 2003. The proposed rule prescribes the test procedure to measure the power consumption of STBs in the on, sleep, and off modes of operation and the calculation of an annualized energy metric, AEC, as a weighted average of the individual power consumption values. The initial regulatory flexibility analysis (IRFA) below discusses the potential impacts of the test procedure on small businesses and alternatives that would minimize the impact on small businesses consistent with statutory objectives.

(1) Description of the reasons why action by the agency is being considered.

A description of the reasons why DOE is considering this test procedure are stated elsewhere in the preamble and not repeated here.

(2) Succinct statement of the objectives of, and legal basis for, the proposed rule.

The objectives of and legal basis for the proposed rule are stated elsewhere in the preamble and not repeated here.

(3) Description of and, where feasible, an estimate of the number of small entities to which the proposed rule will apply.

The Small Business Administration (SBA) has set a size threshold for manufacturers of STBs that defines those entities classified as “small businesses” for the purposes of the RFA. DOE used the SBA’s small business size standards to determine whether any small manufacturers of STBs would be subject to the requirements of the rule. 65 FR 30836, 30849 (May 15, 2000), as amended at 65 FR 53533, 53545 (Sept. 5, 2000) and codified at 13 CFR part 121. The size standards are listed by North American Industry Classification System (NAICS) code and industry description and are available at http://www.sba.gov/sites/default/files/files/Size_Standards_Table.pdf. DOE identified three NAICS codes that apply to the manufacturers of STBs. The reasons for selecting the following NAICS codes are discussed in further detail below.

Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing are classified under NAICS 334220. SBA sets a threshold of 750 employees or less for an entity to be considered a small business for this category.

Audio and Video Equipment Manufacturing are classified under NAICS 334310. SBA sets a threshold of 750 employees or less for an entity to be considered a small business for this category.

Cable and Other Subscription Programming are classified under NAICS 515210. The SBA threshold to qualify as a small business for this category requires that the average annual receipts should be \$15,000,000 or less.

NAICS code 334220 – Radio and Television Broadcasting and Wireless Communications Equipment Manufacturing covers manufacturers of all products except OTT STBs. Because some manufacturers of OTT STBs were not listed under NAICS code 334220, DOE added consideration of small business manufacturers listed under NAICS code 334310 – Audio and Video Equipment Manufacturing. Additionally, DOE included a search for small businesses listed under NAICS code 515210 – Cable and Other Subscription Programming as some businesses in this category would also be subject to today’s rulemaking based on the definition of manufacturer discussed in section III.D.3 of the NOPR.

To determine the number of small business manufacturers of STBs in each NAICS code category, DOE compiled a preliminary list of potential small business manufacturers of STBs by searching the Hoovers³³ and SBA databases. DOE confirmed if the companies were indeed small businesses by reviewing the company website and/or calling the company. Through this process, DOE identified five small business manufacturers of STBs that manufacture STBs as defined in

³³ Hoovers, Inc. (2012). Search of domestic records matching NAICS codes 334220, 334310, and 515210. Retrieved June 22, 2012, from Hoover’s Company Records database. Available by subscription at www.hoovers.com.

section III.D.1. Of these five small business manufacturers, DOE identified two small business manufacturers each under NAICS codes 334220 and 334310 and one small business manufacturer under NAICS code 515210. DOE invites interested parties to comment on the expected number of small business manufacturers of STBs.

(4) Description of the projected reporting, recordkeeping and other compliance requirements of the proposed rule.

To determine the costs of the proposed test procedure on small STB manufacturers, DOE estimated the cost of testing two STBs, the minimum required sample size as discussed in section III.H of this NOPR. DOE estimated a one time setup cost and a labor cost for performing the tests. The labor cost of testing was then multiplied over the estimated number of basic models produced by a small manufacturer. The estimated cost of testing is discussed in further detail below.

For the initial setup for testing STBs, manufacturers require power supply, power meter, cables to connect equipment, and hardware and software instrumentation to measure the power consumption of the STB. DOE estimated an approximate cost of \$4,000 for the power supply and \$3,000 for the power meter. Further, the equipment cost for cables, monitors, and software was estimated at approximately \$3,100 for a total initial setup cost of approximately \$10,100.

DOE then estimated the time required to test each basic model of STB based on conservative estimates of the duration proposed for each test in the on, sleep, and off modes of operation. DOE's estimates assume the longest proposed duration for the tests in sleep mode

(that is, 8 hours) and are as follows: 1 hour to setup and warm-up the STB; half an hour each to perform the on (watch TV) test and multi-stream test of the STB in on mode; 8 hours for the manual sleep test; 12 hours to test the STB in APD; and, half an hour to test the STB in off mode. The total number of hours required to test one STB would be 22.5 hours. For testing two STBs by an electronics engineer whose rate is \$40.98 per hour³⁴, the labor cost would be approximately \$1,850 for each STB model. Estimates for the labor cost associated with testing are based on feedback received during manufacturer interviews and Bureau of Labor Statistics regarding average salaries for engineering staff. For the five small business manufacturers of STBs that DOE identified, the average number of models produced per manufacturer is four. Therefore, for testing an average of four STB models, the testing cost in the first year would be approximately \$7,400. DOE expects this cost to be lower in subsequent years because only new or redesigned STB models would need to be tested.

DOE used company reports from Dunn & Bradstreet to estimate the revenue for the five small business manufacturers identified. DOE then applied an industry weighted average research and development estimate to determine the budget for research and development for each small business. The average revenue of the five small business manufacturers is approximately \$21.8M and the average budget for research and development is approximately \$2.02M, or 9.4 percent of revenues. Relative to the average revenue and average research and development budget per small business manufacturer, the total testing cost in the first year is approximately \$17,100. This cost is less than 0.1 percent of the average revenue and

³⁴ Obtained from the Bureau of Labor Statistics (National Compensation Survey: Occupational Earnings in the United States 2008, U.S. Department of Labor (August 2009), Bulletin 2720, Table 3 (“Full-time civilian workers,” mean and median hourly wages) < <http://bls.gov/ncs/ocs/sp/nctb0717.pdf>>

approximately 0.1 percent of the average research and development budget; that is, DOE believes the cost of testing STBs is relatively small. Therefore, DOE has tentatively concluded that testing costs would not be significant enough to pose a substantial burden on small manufacturers. DOE requests comments on its analysis of burden to small businesses for testing STBs according to the proposed test procedure.

(5) Relevant Federal rules which may duplicate, overlap or conflict with the proposed rule.

This proposed rule would, if adopted, establish a test procedure for STBs. DOE is not aware of any other Federal rules that establish such a procedure or would otherwise duplicate, overlap or conflict with this test procedure.

(6) Description of any significant alternatives to the proposed rule.

DOE considered a number of existing and under-development industry standards that measure the energy consumption of STBs to develop the proposed test procedure in today's rulemaking as discussed in section III.C of the NOPR. Of the standards reviewed, today's proposed rule is primarily based on the draft CEA-2043 standard because DOE believes it provides most of the information required for testing STBs and expects this standard to be adopted across industry to test the power consumption of STBs. DOE seeks comment and information on the need, if any, for alternative test methods that, consistent with the statutory requirements, would reduce the economic impact of the rule on small entities. DOE will consider any comments received regarding alternative methods of testing that would reduce economic

impact of the rule on small entities. DOE will consider the feasibility of such alternatives and determine whether they should be incorporated into the final rule.

C. Review Under the Paperwork Reduction Act of 1995

There is currently no information collection requirement related to the test procedure for STBs. In the event that DOE proposes to require the collection of information derived from the testing of STBs according to this test procedure, DOE will seek OMB approval of such information collection requirement.

DOE established regulations for the certification and recordkeeping requirements for certain covered consumer products and commercial equipment. 76 FR 12422 (March 7, 2011). The collection-of-information requirement for the certification and recordkeeping was subject to review and approval by OMB under the Paperwork Reduction Act (PRA). This requirement was approved by OMB under OMB Control Number 1910-1400. Public reporting burden for the certification was estimated to average 20 hours per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information.

As stated above, in the event DOE proposes to require the collection of information derived from the testing of STBs according to this test procedure, DOE will seek OMB approval of the associated information collection requirement. DOE will seek approval either through a proposed amendment to the information collection requirement approved under OMB control number 1910-1400 or as a separate proposed information collection requirement.

Notwithstanding any other provision of the law, no person is required to respond to, nor shall any person be subject to a penalty for failure to comply with, a collection of information subject to the requirements of the PRA, unless that collection of information displays a currently valid OMB Control Number.

D. Review Under the National Environmental Policy Act of 1969

In this proposed rule, DOE proposes a test procedure for STBs that it expects will be used to develop and implement any future energy conservation standard. DOE has determined that this rule falls into a class of actions that are categorically excluded from review under the National Environmental Policy Act of 1969 (42 U.S.C. 4321 *et seq.*) and DOE's implementing regulations at 10 CFR part 1021. Specifically, this proposed rule would propose a test procedure without affecting the amount, quality or distribution of energy usage, and, therefore, would not result in any environmental impacts. Thus, this rulemaking is covered by Categorical Exclusion A5 under 10 CFR part 1021, subpart D, which applies to any rulemaking that does not result in any environmental impacts. Accordingly, neither an environmental assessment nor an environmental impact statement is required.

E. Review Under Executive Order 13132

Executive Order 13132, "Federalism," 64 FR 43255 (August 4, 1999) imposes certain requirements on agencies formulating and implementing policies or regulations that preempt State law or that have Federalism implications. The Executive Order requires agencies to examine the constitutional and statutory authority supporting any action that would limit the policymaking discretion of the States and to carefully assess the necessity for such actions. The Executive Order also requires agencies to have an accountable process to ensure meaningful and

timely input by State and local officials in the development of regulatory policies that have Federalism implications. On March 14, 2000, DOE published a statement of policy describing the intergovernmental consultation process it will follow in the development of such regulations. 65 FR 13735. DOE has examined this proposed rule and has determined that it would not have a substantial direct effect on the States, on the relationship between the national government and the States, or on the distribution of power and responsibilities among the various levels of government. EPCA governs and prescribes Federal preemption of State regulations as to energy conservation for the products that are the subject of today's proposed rule. States can petition DOE for exemption from such preemption to the extent, and based on criteria, set forth in EPCA. (42 U.S.C. 6297(d)) No further action is required by Executive Order 13132.

F. Review Under Executive Order 12988

Regarding the review of existing regulations and the promulgation of new regulations, section 3(a) of Executive Order 12988, "Civil Justice Reform," 61 FR 4729 (Feb. 7, 1996), imposes on Federal agencies the general duty to adhere to the following requirements: (1) eliminate drafting errors and ambiguity; (2) write regulations to minimize litigation; (3) provide a clear legal standard for affected conduct rather than a general standard; and (4) promote simplification and burden reduction. Section 3(b) of Executive Order 12988 specifically requires that Executive agencies make every reasonable effort to ensure that the regulation: (1) clearly specifies the preemptive effect, if any; (2) clearly specifies any effect on existing Federal law or regulation; (3) provides a clear legal standard for affected conduct while promoting simplification and burden reduction; (4) specifies the retroactive effect, if any; (5) adequately defines key terms; and (6) addresses other important issues affecting clarity and general draftsmanship under any guidelines issued by the Attorney General. Section 3(c) of Executive

Order 12988 requires Executive agencies to review regulations in light of applicable standards in sections 3(a) and 3(b) to determine whether they are met or it is unreasonable to meet one or more of them. DOE has completed the required review and determined that, to the extent permitted by law, the proposed rule meets the relevant standards of Executive Order 12988.

G. Review Under the Unfunded Mandates Reform Act of 1995

Title II of the Unfunded Mandates Reform Act of 1995 (UMRA) requires each Federal agency to assess the effects of Federal regulatory actions on State, local, and Tribal governments and the private sector. Pub. L. No. 104-4, sec. 201 (codified at 2 U.S.C. 1531). For a proposed regulatory action likely to result in a rule that may cause the expenditure by State, local, and Tribal governments, in the aggregate, or by the private sector of \$100 million or more in any one year (adjusted annually for inflation), section 202 of UMRA requires a Federal agency to publish a written statement that estimates the resulting costs, benefits, and other effects on the national economy. (2 U.S.C. 1532(a), (b)) The UMRA also requires a Federal agency to develop an effective process to permit timely input by elected officers of State, local, and Tribal governments on a proposed “significant intergovernmental mandate,” and requires an agency plan for giving notice and opportunity for timely input to potentially affected small governments before establishing any requirements that might significantly or uniquely affect small governments. On March 18, 1997, DOE published a statement of policy on its process for intergovernmental consultation under UMRA. 62 FR 12820; also available at <http://energy.gov/gc/office-general-counsel>. DOE examined today’s proposed rule according to UMRA and its statement of policy and determined that the rule contains neither an intergovernmental mandate, nor a mandate that may result in the expenditure of \$100 million or more in any year, so these requirements do not apply.

H. Review Under the Treasury and General Government Appropriations Act, 1999

Section 654 of the Treasury and General Government Appropriations Act, 1999 (Pub. L. 105-277) requires Federal agencies to issue a Family Policymaking Assessment for any rule that may affect family well-being. This rule would not have any impact on the autonomy or integrity of the family as an institution. Accordingly, DOE has concluded that it is not necessary to prepare a Family Policymaking Assessment.

I. Review Under Executive Order 12630

DOE has determined, under Executive Order 12630, “Governmental Actions and Interference with Constitutionally Protected Property Rights” 53 FR 8859 (March 18, 1988), that this regulation would not result in any takings that might require compensation under the Fifth Amendment to the U.S. Constitution.

J. Review Under Treasury and General Government Appropriations Act, 2001

Section 515 of the Treasury and General Government Appropriations Act, 2001 (44 U.S.C. 3516 note) provides for agencies to review most disseminations of information to the public under guidelines established by each agency pursuant to general guidelines issued by OMB. OMB’s guidelines were published at 67 FR 8452 (Feb. 22, 2002), and DOE’s guidelines were published at 67 FR 62446 (Oct. 7, 2002). DOE has reviewed today’s proposed rule under the OMB and DOE guidelines and has concluded that it is consistent with applicable policies in those guidelines.

K. Review Under Executive Order 13211

Executive Order 13211, “Actions Concerning Regulations That Significantly Affect Energy Supply, Distribution, or Use,” 66 FR 28355 (May 22, 2001), requires Federal agencies to prepare and submit to OMB, a Statement of Energy Effects for any proposed significant energy action. A “significant energy action” is defined as any action by an agency that promulgated or is expected to lead to promulgation of a final rule, and that: (1) is a significant regulatory action under Executive Order 12866, or any successor order; and (2) is likely to have a significant adverse effect on the supply, distribution, or use of energy; or (3) is designated by the Administrator of OIRA as a significant energy action. For any proposed significant energy action, the agency must give a detailed statement of any adverse effects on energy supply, distribution, or use should the proposal be implemented, and of reasonable alternatives to the action and their expected benefits on energy supply, distribution, and use.

Today’s regulatory action to establish a test procedure for measuring the energy consumption of STBs is not a significant regulatory action under Executive Order 12866. Moreover, it would not have a significant adverse effect on the supply, distribution, or use of energy, nor has it been designated as a significant energy action by the Administrator of OIRA. Therefore, it is not a significant energy action, and, accordingly, DOE has not prepared a Statement of Energy Effects.

L. Review Under Section 32 of the Federal Energy Administration Act of 1974

Under section 301 of the Department of Energy Organization Act (Pub. L. 95–91; 42 U.S.C. 7101), DOE must comply with section 32 of the Federal Energy Administration Act of 1974, as amended by the Federal Energy Administration Authorization Act of 1977. (15 U.S.C.

788; FEAA) Section 32 essentially provides in relevant part that, where a proposed rule authorizes or requires use of commercial standards, the notice of proposed rulemaking must inform the public of the use and background of such standards. In addition, section 32(c) requires DOE to consult with the Attorney General and the Chairman of the Federal Trade Commission (FTC) concerning the impact of the commercial or industry standards on competition.

The proposed rule incorporates the following commercial standards: CEA-770.3-D, “High Definition TV Analog Component Video Interface;” HDMI Specification Version 1.0, “High-Definition Multimedia Interface Specification;” ISO/IEC 7816-12, “Identification cards – Integrated circuit cards – Part 12: Cards with contacts – USB electrical interface and operating procedures;” ANSI/SCTE 28 2007, “HOST-POD Interface Standard;” ANSI/SCTE 55-1 2009, “Digital Broadband Delivery System: Out of Band Transport Part 1: Mode A;” and ANSI/SCTE 55-2 2008, “Digital Broadband Delivery System: Out of Band Transport Part 2: Mode B”. These standards would be incorporated by reference in 10 CFR 430.3 (Materials incorporated by reference). The incorporated standards are respectively used to describe Component Video, HDMI, POD, smart card, and equipment that communicate with the STB. The Department has evaluated these standards and is unable to conclude whether these industry standards fully comply with the requirements of section 32(b) of the FEAA, (i.e., that they were developed in a manner that fully provides for public participation, comment, and review). DOE will consult with the Attorney General and the Chairman of the FTC concerning the impact of these test procedures on competition, prior to prescribing a final rule.

V. Public Participation

A. Attendance at Public Meeting

The time, date and location of the public meeting are listed in the DATES and ADDRESSES sections at the beginning of this document. If you plan to attend the public meeting, please notify Ms. Brenda Edwards at (202) 586-2945 or Brenda.Edwards@ee.doe.gov. As explained in the ADDRESSES section, foreign nationals visiting DOE Headquarters are subject to advance security screening procedures.

In addition, you can attend the public meeting via webinar. Webinar registration information, participant instructions, and information about the capabilities available to webinar participants will be published on DOE's website http://www1.eere.energy.gov/buildings/appliance_standards/residential/set_top_boxes.html. Participants are responsible for ensuring their systems are compatible with the webinar software.

B. Procedure for Submitting Prepared General Statements For Distribution

Any person who has plans to present a prepared general statement may request that copies of his or her statement be made available at the public meeting. Such persons may submit requests, along with an advance electronic copy of their statement in PDF (preferred), Microsoft Word or Excel, WordPerfect, or text (ASCII) file format, to the appropriate address shown in the ADDRESSES section at the beginning of this notice. The request and advance copy of statements must be received at least one week before the public meeting and may be emailed, hand-delivered, or sent by mail. DOE prefers to receive requests and advance copies via email. Please include a telephone number to enable DOE staff to make a follow-up contact, if needed.

C. Conduct of Public Meeting

DOE will designate a DOE official to preside at the public meeting and may also use a professional facilitator to aid discussion. The meeting will not be a judicial or evidentiary-type public hearing, but DOE will conduct it in accordance with section 336 of EPCA (42 U.S.C. 6306). A court reporter will be present to record the proceedings and prepare a transcript. DOE reserves the right to schedule the order of presentations and to establish the procedures governing the conduct of the public meeting. After the public meeting, interested parties may submit further comments on the proceedings as well as on any aspect of the rulemaking until the end of the comment period.

The public meeting will be conducted in an informal, conference style. DOE will present summaries of comments received before the public meeting, allow time for prepared general statements by participants, and encourage all interested parties to share their views on issues affecting this rulemaking. Each participant will be allowed to make a general statement (within time limits determined by DOE), before the discussion of specific topics. DOE will allow, as time permits, other participants to comment briefly on any general statements.

At the end of all prepared statements on a topic, DOE will permit participants to clarify their statements briefly and comment on statements made by others. Participants should be prepared to answer questions by DOE and by other participants concerning these issues. DOE representatives may also ask questions of participants concerning other matters relevant to this rulemaking. The official conducting the public meeting will accept additional comments or questions from those attending, as time permits. The presiding official will announce any further

procedural rules or modification of the above procedures that may be needed for the proper conduct of the public meeting.

A transcript of the public meeting will be included in the docket, which can be viewed as described in the Docket section at the beginning of this notice. In addition, any person may buy a copy of the transcript from the transcribing reporter.

D. Submission of Comments

DOE will accept comments, data, and information regarding this proposed rule before or after the public meeting, but no later than the date provided in the DATES section at the beginning of this proposed rule. Interested parties may submit comments using any of the methods described in the ADDRESSES section at the beginning of this notice.

Submitting comments via regulations.gov. The regulations.gov web page will require you to provide your name and contact information. Your contact information will be viewable to DOE Building Technologies staff only. Your contact information will not be publicly viewable except for your first and last names, organization name (if any), and submitter representative name (if any). If your comment is not processed properly because of technical difficulties, DOE will use this information to contact you. If DOE cannot read your comment due to technical difficulties and cannot contact you for clarification, DOE may not be able to consider your comment.

However, your contact information will be publicly viewable if you include it in the comment or in any documents attached to your comment. Any information that you do not want

to be publicly viewable should not be included in your comment, nor in any document attached to your comment. Persons viewing comments will see only first and last names, organization names, correspondence containing comments, and any documents submitted with the comments.

Do not submit to regulations.gov information for which disclosure is restricted by statute, such as trade secrets and commercial or financial information (hereinafter referred to as Confidential Business Information (CBI)). Comments submitted through regulations.gov cannot be claimed as CBI. Comments received through the website will waive any CBI claims for the information submitted. For information on submitting CBI, see the Confidential Business Information section.

DOE processes submissions made through regulations.gov before posting. Normally, comments will be posted within a few days of being submitted. However, if large volumes of comments are being processed simultaneously, your comment may not be viewable for up to several weeks. Please keep the comment tracking number that regulations.gov provides after you have successfully uploaded your comment.

Submitting comments via email, hand delivery, or mail. Comments and documents submitted via email, hand delivery, or mail also will be posted to regulations.gov. If you do not want your personal contact information to be publicly viewable, do not include it in your comment or any accompanying documents. Instead, provide your contact information on a cover letter. Include your first and last names, email address, telephone number, and optional mailing address. The cover letter will not be publicly viewable as long as it does not include any comments

Include contact information each time you submit comments, data, documents, and other information to DOE. If you submit via mail or hand delivery, please provide all items on a CD, if feasible. It is not necessary to submit printed copies. No facsimiles (faxes) will be accepted.

Comments, data, and other information submitted to DOE electronically should be provided in PDF (preferred), Microsoft Word or Excel, WordPerfect, or text (ASCII) file format. Provide documents that are not secured, written in English and are free of any defects or viruses. Documents should not contain special characters or any form of encryption and, if possible, they should carry the electronic signature of the author.

Campaign form letters. Please submit campaign form letters by the originating organization in batches of between 50 to 500 form letters per PDF or as one form letter with a list of supporters' names compiled into one or more PDFs. This reduces comment processing and posting time.

Confidential Business Information. According to 10 CFR 1004.11, any person submitting information that he or she believes to be confidential and exempt by law from public disclosure should submit via email, postal mail, or hand delivery two well-marked copies: one copy of the document marked confidential including all the information believed to be confidential, and one copy of the document marked non-confidential with the information believed to be confidential deleted. Submit these documents via email or on a CD, if feasible. DOE will make its own determination about the confidential status of the information and treat it according to its determination.

Factors of interest to DOE when evaluating requests to treat submitted information as confidential include: (1) A description of the items; (2) whether and why such items are customarily treated as confidential within the industry; (3) whether the information is generally known by or available from other sources; (4) whether the information has previously been made available to others without obligation concerning its confidentiality; (5) an explanation of the competitive injury to the submitting person which would result from public disclosure; (6) when such information might lose its confidential character due to the passage of time; and (7) why disclosure of the information would be contrary to the public interest.

It is DOE's policy that all comments may be included in the public docket, without change and as received, including any personal information provided in the comments (except information deemed to be exempt from public disclosure).

E. Issues on Which DOE Seeks Comment

Although DOE welcomes comments on any aspect of this proposal, DOE is particularly interested in receiving comments and views of interested parties concerning the following issues:

1. DOE requests comment on narrowing the scope of today's rulemaking to STBs and excluding network equipment. See section III.B for further detail.
2. DOE requests comment on using the draft CEA-2043 standard as the basis for today's proposed test procedure for STBs. See section III.C for further detail.

3. DOE requests comment on the proposed definition of STBs. In particular, DOE requests comment about whether the proposed definition is specific enough to exclude non-STB devices such as gaming consoles and smartphones, yet broad enough to cover traditional STBs and newer boxes. DOE also requests comment on the proposed definitions for direct video connection, HDMI, Component Video, S-Video, and Composite Video. See section III.D.1 for further detail.

4. DOE invites comment on the discussion of basic model as it pertains to the STB rulemaking. See section III.D.2 for further detail.

5. DOE invites interested parties to comment on the proposed definitions for the STB test procedure NOPR including the definitions for content provider and multi-stream and clarifying information included for the definitions of DVR, display device, and HNI. For the definition of DVR, DOE requests comment on the proposed approach of not testing STBs with external storage as a DVR. If DOE does consider testing the STB with an external storage device as DVR in response to comments, DOE specifically requests comments on the proper external storage device to use. See section III.D.4 for further detail.

6. DOE invites interested parties to comment on the proposed definitions of on, sleep, and off modes of operation of a STB. In particular, DOE requests comment, and data, if available, on the proposed requirement to transition from sleep mode to on mode within 30 seconds, or whether a different maximum allowable transition time should be considered. See section III.D.5 for further detail.

7. DOE requests comment on the proposed requirements for setting up the STB as installed in a consumer's home for testing. See section III.E.1 for further detail.

8. DOE requests comment on the proposed test room conditions for testing STBs, including air temperature, air speed, and thermally non-conductive test surface requirements. In particular, DOE invites interested parties to comment on the proposed air speed requirement of 0.5 m/s and whether this requirement should be relaxed to a higher value or removed altogether. See section III.E.2 for further detail.

9. DOE invites interested parties to comment on the proposed input power requirements for testing STBs. See section III.F.1 for further detail.

10. DOE requests comment on the proposed requirements for the accuracy of measuring the power consumption of STBs. See section III.F.2 for further detail.

11. DOE invites interested parties to comment on the recommended test equipment to measure the AC line current, voltage, and frequency. See section III.F.3 for further detail.

12. DOE requests comment on the proposed power meter instrumentation requirements such as, crest factor, bandwidth, frequency response, and sampling interval requirements. See section III.F.4 for further detail.

13. DOE requests comment on the proposed calibration requirements for testing STBs. See section III.F.5 for further detail.

14. DOE requests comment on the proposed requirements for testing STBs that require an HNI connection. Particularly, DOE requests comment on the proposed order in which HNI connections shall be used, that is, MoCA, followed by HPNA, followed by Wi-Fi, and finally any other connection. DOE also requests comment about whether there are any additional HNI connections that should be included and the order of preference in which they should be included. See section III.F.6.a for further detail.

15. DOE invites interested parties to comment on the proposed setup requirements for STBs requiring broadband service. Particularly, DOE requests comment on the clarification that a service provider network connection should take precedence over a broadband connection for STBs that are designed to operate on either connection. See section III.F.6.b for further detail.

16. DOE requests comment on the proposed exclusion of external equipment power consumption from the power consumption of the STB itself. Further, if stakeholders suggest that the power consumption of external equipment be tested and measured, DOE requests comment on the test method and standard configuration that should be used to test the external equipment. See section III.F.6.c for further detail.

17. DOE requests comment on the proposed exclusion of power consumption of the input signal equipment from the power consumption of the STB. Further, DOE requests comment on the clarification that such equipment should not supply any power to the STB. DOE also requests feedback on the potential use of a DC block to prevent power transfer to and from any input signal equipment. Finally, if stakeholders indicate that this equipment should be tested and the power consumption be measured, DOE requests comment on the test method and standard configuration that should be used to test this equipment. See section III.F.6.d for further detail.

18. DOE invites interested parties to comment on the proposed requirements for service provider network connection. In particular, DOE requests comment and data, if available, about whether the power consumption of a STB is similar on a live network versus a closed network. See section III.F.6.e for further detail.

19. DOE requests comment on the proposed warm-up time for stabilizing the STB. See section III.G.1 for further detail.

20. DOE invites interested parties to comment on all aspects of the proposed configuration for testing STBs in the on, sleep, and off modes of operation. DOE is especially interested in receiving comments on the proposed connections for the test configuration. DOE also invites comments on the proposed order of preference for connecting a display device to the STB. See section III.G.2 for further information.

21. DOE requests comment on the proposed requirements for streaming an appropriate SD or HD stream to a display device. DOE also invites comment on the proposed requirement to record content on a DVR integrated into the STB. Finally, DOE requests comment on the proposed requirements to stream content to a connected client. Specifically, DOE requests comment on the proposed hierarchy of content to stream to a connected client, which is a recorded stream followed by a channel. See section III.G.3 for further detail.

22. DOE requests comment on the proposed methods to determine the average power consumption of the STB in each mode of operation. See section III.G.4 for further detail.

23. DOE invites comment on all aspects of the proposed approach for testing the STB in the on mode including the proposed time period of 2 minutes for all tests in the on mode. The on mode measurement test includes the on (watch TV) test and multi-stream test. See section III.G.5 for further detail.

24. DOE requests comment on the proposed method for the on (watch TV) test. In particular, DOE requests comment on the approach of using both, an SD and HD stream for testing HD STBs. DOE also requests interested parties to comment, and provide data if available, on the percentage of streams that are available in SD and HD for HD STBs, and whether the proposed equation for calculating P_{WATCH} should be changed. See section III.G.5.a for further detail.

25. DOE requests comment on the approach of using a single multi-stream test as well as the test procedure to test STBs with multi-streaming capability. DOE is especially interested in receiving comments on the proposed priority list for enabling streams for testing STBs with multi-streaming capability. DOE also seeks feedback on whether the number of additional streams that should be enabled should be other than three and the reasons for enabling a different number of streams. DOE requests comment on the possibility of including a maximum power test, which would test the STB such that the maximum number of streams is enabled. If included, DOE requests comment on the weighting that should be applied for the maximum streaming test in the calculation of the AEC. See section III.G.5.b for further detail.

26. DOE requests comment on all aspects of the proposed specification for setting up STBs for testing in sleep mode. In particular, DOE invites comment on the proposed duration (4 to 8 hours unless network activities prompt a longer time period) over which the power consumption of the STB shall be measured and averaged, and whether this duration should be increased or decreased to better represent the STB power consumption in sleep mode. See section III.G.6 for further detail.

27. DOE also requests comment on the proposed scheduled recording requirement prior to placing the STB in sleep mode to measure its power consumption. DOE requests interested parties to provide data, if available, on the variation in power consumption of a STB when a recording is scheduled versus when it is not scheduled. See section III.G.6 for further detail.

28. DOE invites interested parties to comment on all aspects of the proposed method to address network initiated actions. DOE requests comment and data, if available, on the approach proposed in today's NOPR, the approaches that were considered but have not been proposed, as well as any other approach that stakeholders believe would best capture the transition of the STB from sleep mode to on mode due to network initiated activities. See section III.G.6 for further detail.

29. DOE invites comments on the proposed requirements for testing STBs in manual sleep mode. See section III.G.6.a for further detail.

30. DOE requests comment on the proposed test for determining the STB power consumption in APD. In particular, DOE requests comment and data, if available, on the time required to transition to sleep mode from on mode and whether this time period should be set at a default value of 4 hours or adjusted during testing. DOE also requests comment on potential methods to scale APD and the advantages and disadvantages of scaling the power consumption in APD. Finally, DOE requests comment on potential methods to account for a scaling APD value in the AEC metric. See section III.G.6.b for further detail.

31. DOE invites interested parties to comment on the proposed requirements for testing STBs in off mode. See section III.G.7 for further detail.

32. DOE requests comment on the proposed sleep to on mode transition time measurement test. See section III.G.8 for further detail.

33. DOE requests comment on the proposed sampling plan and rounding requirements for making representations of the STB power consumption in each mode of operation. DOE also requests comment on proposed rounding requirements for AEC, which is calculated from the rated power consumption values. See section III.H for further detail.

34. DOE requests comment on the proposed calculation of the AEC metric for determining the annual energy consumption of the STB. DOE requests comment on the proposed hour weightings that were developed based on the ENERGY STAR specification or whether the alternate hour weightings should be considered instead. DOE also invites comment and data, if available, on the time coefficients for each mode of operation to calculate the AEC. See section III.I for further detail.

35. DOE requests comment on the analysis of the burden to small businesses for testing STBs according to the proposed test procedure. DOE also requests comment on the expected number of small business manufacturers of STBs. See section IV.B for further detail.

36. DOE requests additional information and comment for the development of a test procedure for LNBs, ONTs, ODU, or other infrastructure devices and the standard

configuration in which these devices should be tested, if stakeholders support developing a test procedure for them. See section III.B for further detail.

VI. Approval of the Office of the Secretary

The Secretary of Energy has approved publication of this proposed rule.

List of Subjects

10 CFR Part 429

Confidential business information, Energy conservation, Household appliances, Imports, Reporting and recordkeeping requirements.

10 CFR Part 430

Administrative practice and procedure, Confidential business information, Energy conservation, Household appliances, Imports, Incorporation by reference, Intergovernmental relations, Small businesses.

Issued in Washington, DC, on January 11, 2013.

Kathleen B. Hogan
Deputy Assistant Secretary of Energy Efficiency
Energy Efficiency and Renewable Energy

For the reasons stated in the preamble, DOE is proposing to amend parts 429 and 430 of Chapter II of Title 10, Subchapter D of the Code of Federal Regulations to read as set forth below:

**PART 429—CERTIFICATION, COMPLIANCE, AND ENFORCEMENT FOR
CONSUMER PRODUCTS AND COMMERCIAL AND INDUSTRIAL EQUIPMENT**

1. The authority citation for part 429 continues to read as follows:

Authority: 42 U.S.C. 6291-6317.

§429.11 [Amended]

2. Section 429.11 is amended in paragraphs (a) and (b) by removing “429.54” and adding in its place “429.55”.
3. Section 429.55 is added to read as follows:

§429.55 Set-top boxes.

(a) Sampling plan for selection of units for testing. (1) The requirements of §429.11 are applicable to set-top boxes; and

(2) For each basic model of set-top box, samples shall be randomly selected and tested to ensure that—

- (i) The represented value of power consumption in the on, sleep, and off modes of operation of a basic model for which consumers would favor lower values shall be greater than or equal to the higher of:

(A) The mean of the sample, where:

$$\bar{x} = \frac{1}{n} \sum_{i=1}^n x_i$$

and, \bar{x} is the sample mean; n is the number of samples; and x_i is the i^{th} sample;

Or,

(B) The upper 95 percent confidence limit (UCL) of the true mean divided by 1.05, where:

$$UCL = \bar{x} + t_{0.95} \left(\frac{s}{\sqrt{n}} \right)$$

And \bar{x} is the sample mean; s is the sample standard deviation; n is the number of samples; and $t_{0.95}$ is the t statistic for a 95 percent one-tailed confidence interval with n-1 degrees of freedom (from Appendix A of this subpart).

and

(ii) Reserved

- (3) The represented value of the annual energy consumption shall be calculated from the rated power consumption in the on, sleep, and off modes of operation according to the calculation provided in section 6 of Appendix AA of Subpart B of 10 CFR Part 430.

(b) *Reserved.*

PART 430—ENERGY CONSERVATION PROGRAM FOR CONSUMER PRODUCTS

4. The authority citation for part 430 continues to read as follows:

Authority: 42 U.S.C. 6291–6309; 28 U.S.C. 2461 note.

5. Section 430.2 is amended by adding in alphabetical order the definitions of “Component Video”, “Composite Video”, “Direct video connection”, “High-Definition Multimedia Interface or HDMI”, “Set-top box”, and “S-Video” to read as follows:

§ 430.2 Definitions.

* * * * *

Component Video means a video display interface that meets the specification in CEA-770.3-D (incorporated by reference; see §430.3).

Composite Video means a video display interface that uses a Radio Corporation of America (RCA) connection to transmit National Television System Committee (NTSC) analog video.

* * * * *

Direct video connection means any connection type that is one of the following: High-Definition Multimedia Interface (HDMI), Component Video, S-Video, Composite Video, or any other video interface that may be used to output video content.

* * * * *

High-Definition Multimedia Interface or HDMI means an audio/video interface that meets the specification in HDMI Specification Version 1.0 (incorporated by reference; see §430.3).

* * * * *

Set-top box means a device combining hardware components with software programming designed for the primary purpose of receiving television and related services from terrestrial, cable, satellite, broadband, or local networks, providing video output using at least one direct video connection.

* * * * *

S-Video means a video display interface that transmits analog video over two channels: luminance and color.

* * * * *

6. Section 430.3 is amended by:

- a. Redesignating paragraphs (i) through (k) as paragraphs (j) through (l) and adding a new paragraph (i).
- b. Redesignating paragraph (l) as paragraph (n) and adding a new paragraph (m).
- c. Redesignating paragraph (m) as paragraph (o) and adding paragraph (o)(3).
- d. Redesignating paragraphs (n) and (o) as paragraphs (p) and (q).
- e. Redesignating paragraph (p) as paragraph (s) and adding a new paragraph (r).

The additions read as follows:

§ 430.3 Materials incorporated by reference.

* * * * *

(i) *CEA*. Consumer Electronics Association, Technology & Standards Department, 1919 S. Eads Street, Arlington, VA 22202, 703-907-7600, or go to *www.CE.org*.

(1) CEA-770.3-D, High Definition TV Analog Component Video Interface, approved February 2008; IBR approved for § 430.2.

(2) [Reserved]

* * * * *

(m) *HDMI*. High-Definition Multimedia Interface Licensing, LLC, 1140 East Arques Avenue, Suite 100, Sunnyvale, CA 94085, 408-616-1542, or go to www.hdmi.org.

(1) HDMI Specification Version 1.0, High-Definition Multimedia Interface Specification, Informational Version 1.0, approved September 4, 2003; IBR approved for § 430.2.

(2) [Reserved]

* * * * *

(o) *IEC*. * * *

(3) ISO/IEC 7816-12, Identification cards – Integrated circuit cards – Part 12: Cards with contacts – USB electrical interface and operating procedures, approved October 1, 2005; IBR approved for appendix AA to subpart B.

* * * * *

(r) *SCTE*. Society of Cable Telecommunications Engineers, 140 Philips Road, Exton, PA 19341, 610-363-6888, or go to www.scte.org/standards.

(1) ANSI/SCTE 28 2007 (“ANSI/SCTE 28”), American National Standard, HOST-POD Interface Standard; IBR approved for Appendix AA to Subpart B.

(2) ANSI/SCTE 55-1 2009 (“ANSI/SCTE 55-1”), American National Standard, Digital Broadband Delivery System: Out of Band Transport Part 1: Mode A; IBR approved for appendix AA to subpart B.

(3) ANSI/SCTE 55-2 2008 (“ANSI/SCTE 55-2”), American National Standard, Digital Broadband Delivery System: Out of Band Transport Part 2: Mode B; IBR approved for appendix AA to subpart B.

* * * * *

7. Appendix AA to Subpart B of Part 430 is added to read as follows:

Appendix AA to Subpart B of Part 430—Uniform Test Method for Measuring the Energy Consumption of Set-top Boxes

1. *Scope*: This appendix covers the test requirements to measure the power consumption of set-top boxes (STBs) in the on, sleep, and off modes and provides the method to calculate the annual energy consumption (AEC) of the STB.
2. *Definitions*
 - 2.1. *ANSI* means the American National Standards Institute.
 - 2.2. *Auto power down (APD)* means a STB feature that monitors parameters correlated with user activity or viewing. If the parameters collectively indicate that no user activity or viewing is occurring, the APD feature enables the STB to transition to sleep or off mode.
 - 2.3. *Client* means any device (example: STB, thin-client STB, smart television (TV), mobile phone, tablet, or personal computer) that can receive content over a home network interface (HNI).
 - 2.4. *Content provider* means an entity that provides video programming content.

- 2.5. *Crest factor* means the ratio of the peak current to the root-mean-square (rms) current.
- 2.6. *Digital video recorder (DVR)* means a STB feature that records television signals on a hard disk drive (HDD) or other non-volatile storage device integrated into the STB. A DVR often includes features such as: Play, Record, Pause, Fast Forward (FF), and Fast Rewind (FR). STBs that support a service provider network-based “DVR” service are not considered DVR STBs for purposes of this test procedure. The presence of DVR functionality does not mean the device is defined to be a STB.
- 2.7. *Display device* means a device (example: TV, Computer Monitor, or Portable TV) that receives its content directly from a STB through a video interface (example: High-Definition Multimedia Interface (HDMI), Component Video, Composite Video, or S-Video), not through an HNI, and displays it for viewing.
- 2.8. *Harmonic* means a component of order n of the Fourier series that describes the periodic current or voltage (where n is an integer greater than 1).
- 2.9. *High definition test stream (HD)* means video content delivered to the STB by the content provider to produce a minimum output resolution of 1280×720 pixels in progressive scan mode at a minimum frame rate of 59.94 frames per second (fps) (abbreviated 720p60) or a minimum output resolution of 1920×1080 pixels in interlaced scan mode at 29.97 fps (abbreviated 1080i30).
- 2.10. *Home network interface (HNI)* means an interface with external devices over a local area network (example: Institute of Electrical and Electronics Engineers (IEEE) 802.11 (Wireless-Fidelity or Wi-Fi), Multimedia over Coax Alliance (MoCA), HomePNA alliance (HPNA), IEEE 802.3, HomePlug AV) that is capable of transmitting video content.

- 2.11. *IEC* means International Electrotechnical Commission.
- 2.12. *ISO* means the International Organization for Standardization.
- 2.13. *Low noise block-downconverter (LNB)* means a combination of low-noise amplifier, block-downconverter and intermediate frequencies (IF) amplifier. It takes the received microwave transmission, amplifies it, down-converts the block of frequencies to a lower block of IF where the signal can be amplified and fed to the indoor satellite TV STB using coaxial cable.
- 2.14. *Multi-stream* means a STB feature that may provide independent video content to one or more clients, one or more directly connected TVs, or a DVR.
- 2.15. *Outdoor unit (ODU)* means satellite signal reception components including: a receiving dish, one or more LNBs, and imbedded or independent radio frequency (RF) switches, used to distribute a satellite service provider network to consumer satellite STBs.
- 2.16. *Point of deployment (POD) module* means a plug-in card that complies with the ANSI/SCTE 28 (incorporated by reference; see §430.3) interface and is inserted into a digital-cable-ready device to enable the decryption of services and provide other network control functions.
- 2.17. *Power mode* means a condition or state of a device that broadly characterizes its capabilities, power consumption, power indicator coding, and responsiveness to input.
- 2.18. *Principal STB Function* means functions necessary for selecting, receiving, decoding, decompressing, or delivering video content to a display device, DVR, or client. Monitoring for user or network requests is not considered a principal STB function.
- 2.19. *Satellite STB* means a STB that receives and decodes video content as delivered from a service provider satellite network.

- 2.20. *SCTE* means The Society of Cable Telecommunications Engineers, Inc.
- 2.21. *Service provider* means a business entity that provides video content, a delivery network, and associated installation and support services to subscribers with whom it has an ongoing contractual relationship.
- 2.22. *Smart Card* means a plug-in card that complies with ISO/IEC 7816-12 (incorporated by reference; see §430.3) and is inserted into a satellite STB to enable the decryption of services and provide other network control functions.
- 2.23. *Standard definition test stream (SD)* means video content delivered to the STB by the content provider to produce an output resolution of 640×480 pixels in interlaced scan mode at minimum frame rate of 29.97 fps (abbreviated 480i30).
- 2.24. *Thin-client STB* means a STB that can receive content over an HNI from another STB, but is unable to interface directly to the service provider network.
- 2.25. *Definitions of Power Modes.*
- 2.25.1. *On mode* means the STB is connected to a mains power source. At least one principal STB function is activated and all principal STB functions are provisioned for use. The power consumption in on mode may vary based on specific use and configuration.
- 2.25.2. *Sleep mode* means a range of reduced power states where the STB is connected to a mains power source and is not providing any principal STB function. The STB may transition to on or off mode due to user action, internal signal, or external signal. The power consumed in this mode may vary based on specific use or configuration. If any principal STB function is activated while operating in this mode, the STB is assumed to transition to on mode. Monitoring for user or network

requests is not considered a principal STB function. The STB shall be able to transition from this mode to on mode within 30 seconds to be considered in sleep mode.

2.25.3. *Off mode* means the STB is connected to a mains power source, has been deactivated, and is not providing any function. The STB requires a user action to transition from this mode to on or sleep mode.

Note: Sleep and off modes may not be available on all STBs.

3. *Test Conditions*

3.1. *Set-top Box Settings.*

3.1.1. For STBs that require subscription to a service, select the simplest available video subscription that supports all functionality specified in this test procedure (example: HD streaming, multi-stream, DVR, etc.). That is, select a subscription with TV services only; services with non-video capability, such as telephony, shall not be selected.

3.1.2. If the STB can be installed by the consumer per the manufacturer's instructions without the service of a technician, then install and setup the STB according to the instructions provided in the user manual shipped with the unit. Setup the STB using only those instructions in the user manual. Setup is considered complete once these instructions are followed.

3.1.3. If the STB must be installed by a technician per the manufacturer's instructions, then it shall be setup as installed by the technician using this test procedure. All steps that a technician would follow when installing a STB for use in a consumer residence should be followed. Information about each of the steps that were

performed to setup the STB by a technician shall be recorded and maintained by the manufacturer pursuant to 10 CFR Part 429.71.

3.2. *Test Room.* Tests shall be carried out in a room with the following requirements:

3.2.1. The air speed surrounding the STB shall be less than or equal to 0.5 meters per second (m/s).

3.2.2. The ambient temperature shall be maintained at $23\text{ }^{\circ}\text{C} \pm 5\text{ }^{\circ}\text{C}$ for the duration of the test.

3.2.3. The STB shall be tested on a thermally non-conductive surface.

4. *Test Setup*

4.1. *Test Voltage.* STBs intended to be powered by the alternating current (AC) mains shall utilize a power source with the following requirements:

4.1.1. An input voltage of 115 volts ± 1 percent.

4.1.2. A frequency of 60 hertz ± 1 percent.

4.1.3. Total harmonic distortion of the supply voltage shall not exceed 2 percent up to and including the 13th harmonic.

4.1.4. The peak value of the test voltage shall be between 1.34 and 1.49 times its rms value. That is, the crest factor shall be between 1.34 and 1.49.

4.2. *Measurement Accuracy.* Power measurements of 0.5 watt (W) or greater shall be made with an uncertainty of less than or equal to 2 percent at the 95 percent confidence level. Power measurements of less than 0.5 W shall be made with an uncertainty of less than or equal to 0.01 W at the 95 percent confidence level. The power measurement instrument shall have a resolution of:

- 4.2.1. 0.01 W or better for power measurements of 10 W or less;
- 4.2.2. 0.1 W or better for power measurements of greater than 10 W and up to 100 W;
and
- 4.2.3. 1 watt or better for power measurements of greater than 100 W.

For equipment connected to more than one phase, the power measurement instrument shall be equipped to measure the total power of all of the phases connected.

- 4.3. *Test Equipment.* The following should be considered when selecting test equipment:

- 4.3.1. An oscilloscope with a current probe to monitor AC line current waveform, amplitude, and frequency.
- 4.3.2. A true rms voltmeter to verify voltage at the input of the STB.
- 4.3.3. A frequency counter to verify frequency at the input of the STB.

- 4.4. *True Power Wattmeter.*

- 4.4.1. *Crest factor.* A true power wattmeter shall be used and shall have:

- 4.4.1.1. Accuracy and resolution in accordance with section 4.2.
- 4.4.1.2. Sufficient bandwidth.
- 4.4.1.3. A crest factor rating that is appropriate for the waveforms being measured and capable of reading the available current waveform without clipping the waveform. The peak of the current waveform measured during sleep and on modes for the STB shall be used to determine the crest factor rating and the current range setting. The full-scale value of the selected current range multiplied by the crest factor for that range shall be at least 15 percent greater than the peak current to prevent measurement error.

4.4.2. *Bandwidth.* The current and voltage signal shall be analyzed to determine the highest frequency component (that is, harmonic) with a magnitude greater than 1 percent of the fundamental frequency under the test conditions. The minimum bandwidth of the test instruments shall be determined by the highest frequency component of the signal.

4.4.3. *Frequency response.* A wattmeter with a frequency response of at least 3 kilohertz (kHz) shall be used in order to account for harmonics up to the 50th harmonic.

4.4.4. *Sampling Interval.* The wattmeter shall be capable of sampling at intervals less than or equal to 1 second.

Note: Electronic equipment can cause harmonic waveforms that lead to inaccuracies in power measurements.

4.5. *Calibration.* Test instruments shall be calibrated annually to traceable national standards to ensure that the limits of error in measurement are not greater than ± 0.5 percent of the measured value over the required bandwidth of the output.

4.6. *Network Setup.*

4.6.1. *Home Network Connection.* STB configurations that require the use of a home network (example: thin-client STB) shall use the HNI option according to the following order of preference. The first available connection that the STB supports shall be used:

1. Multimedia over Coaxial Alliance (MoCA);
2. Home PNA Alliance (HPNA);
3. Wi-Fi (802.11); or

4. Other HNI connection.

4.6.2. *Broadband Service.* If the STB includes an HNI, and the HNI shall be connected to broadband service for operation of a principal STB function, it shall be tested while connected to a broadband network. Broadband performance criteria (that is, download speed, upload speed, latency, etc.) shall meet the specified requirements of the STB to fulfill the principal STB functions. For STBs designed to operate both with a broadband connection and a service provider network connection, the service provider connection takes precedence, and the broadband connection shall only be made if the STB requires it for operating a principal STB function.

4.6.3. *Service Provider Network Distribution Equipment.* If the STB requires the use of external equipment to connect the service provider network to the STB, then the power consumption of this equipment shall not be included as part of the STB power measurement. This includes required service provider network distribution equipment such as network gateways, network routers, network bridges, optical network terminals (ONTs), wireless access points, media extenders, or any other device required for distribution of a service provider network to the STB.

4.6.4. *Input Signal Equipment.* When an ODU, over the air (OTA) antenna amplifier, cable TV (CATV) distribution amplifier, or similar signal equipment is required and the power for that equipment is supplied from the STB, then the measurement shall not include the power consumption of that equipment, unless the equipment cannot be powered from a source other than the STB. If the signal equipment cannot be powered from a source other than the STB, then the power for these equipment shall be included in the STB power consumption measurement and the signal equipment

should be configured in its lowest power consuming mode. However, if the signal equipment can be powered from a source other than the STB, then it shall be powered from another source, and such equipment shall not deliver any power to the connected STB.

4.6.5. *Service Provider Network Connection.* The STB shall be tested with a specific service provider network or a simulated environment verified by the service provider, and the STB shall be configured to simulate a subscriber operating environment. This shall include the ability to access the full services of the service provider network required by the STB, such as content, program guides, software updates, and other STB features that require network services to fully function. If the STB requires a POD or Smart Card, then it shall be connected, authorized, and operational. Essential STB peripheral devices, required for the normal operation of the STB, such as a Universal Serial Bus (USB) powered external HDD, a USB powered Wi-Fi dongle, or a USB powered OTA receiver, shall be connected and operational. Optional peripheral devices shall not be connected to the STB. The STB may be tested in a laboratory environment containing control equipment comparable to a live service provider system. For example, a cable STB may be tested in a laboratory that contains a conditional access system, the appropriate equipment to communicate with the STB (example: ANSI/SCTE 55-1 (incorporated by reference; see §430.3) or ANSI/SCTE 55-2 forward and reverse data channel hardware or data-over-cable service interface specification (DOCSIS) infrastructure), and the appropriate interconnections (example: diplexers, splitters, and coaxial cables).

5. *Test Procedure for Determining the Power Consumption of the Set-top Box in different Modes of Operation*

5.1. *Set-top Box Warm-up.* Allow the STB to operate in on mode while receiving and decoding video for at least 15 minutes so the STB can achieve stable condition.

5.2. *Test Configuration Information.*

5.2.1. The display device and client setup is described in Table 1 of this appendix.

Based on the capability of the STB, the appropriate number of display devices and clients shall be connected.

Table 1: Display Device and Client Connection Setup.

Supports Multiple Display Devices?	Supports DVR?	Supports Clients?	Number of Connected Display Devices	Number of Connected Clients
X	X	X	1	1
X	X		2	0
X		X	2	1
	X	X	1	1
X			2 or 3*	0
	X		1	0
		X	1	1 or 2*
			1	0

* The highest number of connections supported by the STB shall be used.

5.2.2. *Connecting to a Display Device.* The STB shall be connected to the number of display devices required based on the setup requirements specified in Table 1. The following order of preference shall be used to connect each display device to the STB. The first available connection that the STB supports shall be used:

1. HDMI
2. Component Video

3. S-Video
4. Composite Video
5. Other video interface

5.2.3. *Connecting to a Client.* The STB shall be connected to the number of clients required based on the setup requirements specified in Table 1. An HNI connection shall be used to connect the client to the STB. The order of preference in which an HNI connection shall be selected is specified in section 4.6.1.

5.3. *Test Conduct.*

The following section is provided as guidance when conducting the various on, sleep, and off mode tests. When multiple streams are enabled, different content shall be selected to output to a display device, record on a DVR integrated into the STB, and stream to a connected client.

5.3.1. *Output to a Display Device.* For tests requiring output to a display device, a channel shall be selected and viewed on the connected display device(s) as required by the test configuration. For STBs that do not support channels, an appropriate SD or HD test stream shall be selected and the content shall be viewed as indicated. If more than one display device is connected to the STB based on the test configuration from Table 1, then the content outputted on each display device shall be different.

5.3.2. *Recording for a STB with DVR capability.* For tests that require recording on a DVR, a channel shall be selected using a connected display device or a client and the program shall be recorded. If more than one recording is enabled on a DVR that is integrated into the STB, the content for each recording shall be different.

5.3.3. *Streaming to a Connected Client.* The content streamed to a client shall be selected in the following order of preference depending on the number of streams enabled. The first available stream that is supported by each connected client shall be enabled and the content on each stream shall be different.

5.3.3.1. Stream with recorded content. That is, previously recorded content shall be viewed on a display device connected to a client.

5.3.3.2. Stream with channel content. That is, a channel (SD stream for an SD client and HD stream for an HD client) shall be viewed on the connected display device. For clients that do not support channels, select an appropriate SD or HD test stream and view the content as indicated.

5.3.3.3. Other streaming option. If the streams from sections 5.3.3.1 and 5.3.3.2 are not supported, use another stream that is available.

5.4. *Calculation of Average and Rated Power Consumption.*

5.4.1. For all tests in the on, sleep, and off modes (sections 5.5, 5.6, and 5.7), the average power shall be calculated using one of the following two methods:

5.4.1.1. Record the accumulated energy (E_i) in kilo-watt hours (kWh) consumed over the time period specified for each test (T_i). The average power consumption is calculated as $P_i = E_i/T_i$.

5.4.1.2. Record the average power consumption (P_i) by sampling the power at a rate of at least 1 sample per second and computing the arithmetic mean of all samples over the time period specified for each test (T_i).

5.4.2. The rated power consumption in the on, sleep, and off modes shall be determined as follows:

5.4.2.1. Apply the sampling and statistical requirements described in 10 CFR Part 429.55 to the average power consumption values in each mode of operation.

5.4.2.2. The resulting rated power consumption value, for each mode of operation, shall be rounded according to the accuracy requirements specified in section 4.2.

5.5. *On Mode Power Measurement.*

5.5.1. The time period for each test in the on mode (sections 5.5.2 and 5.5.3), T_{ON} , is 2 minutes.

5.5.2. *On (Watch TV).* The on (watch TV) test shall be performed on all STBs as follows.

5.5.2.1. *On (Watch TV SD).*

5.5.2.1.1. Configure the STB as specified in section 5.2.

5.5.2.1.2. Of all the connections to the STB, only one stream shall be enabled and shall stream to a display device. No additional streams shall be sent to other connected display devices and/or clients.

5.5.2.1.3. If supported, select an SD channel and view on the connected display device. For STBs using a content provider that does not support channels, select an appropriate SD test stream and view the content as indicated.

5.5.2.1.4. Begin on mode power consumption measurement and record the average power consumption with the SD source content for 2 minutes as P_{WATCH_SD} .

5.5.2.2. *On (Watch TV HD).*

5.5.2.2.1. If the STB supports HD streaming, repeat the test in section 5.5.2 using HD content instead of SD content and record this value as

P_{WATCH_HD} .

5.5.2.3. *Calculation of P_{WATCH} .* Compute P_{WATCH} according to the following equation:

$$P_{WATCH} = \begin{cases} \frac{P_{WATCH_SD} + P_{WATCH_HD}}{2}, & \text{STB supports HD} \\ P_{WATCH_SD}, & \text{STB doesn't support HD} \end{cases}$$

Where:

P_{WATCH} = the power consumption (in watts (W)) in on (watch TV) mode,

P_{WATCH_SD} = the power consumption (in W) in on (watch TV SD) mode when an SD test stream is used, and

P_{WATCH_HD} = the power consumption (in W) in on (watch TV HD) state when an HD test stream is used.

5.5.3. Multi-stream

5.5.3.1. Perform this test only if the STB supports multi-streaming as defined in section 2.14.

5.5.3.2. Configure the STB as specified in section 5.2 of this appendix. Table 2 of this appendix describes how to setup the multi-stream test. Choose the highest priority (smallest number option) that the STB supports.

Table 2: Priority List for the Multi-stream Test.

Priority for Enabling Multi-streaming - 1 is highest priority - 9 is lowest priority	Number of Streams Enabled:		
	To Display Devices	To Record on DVR	To Connect to Clients
1	1	1	1
2	2	1	-
3	2	-	1

4	1	2	-
5	1	-	2
6	3	-	-
7	1	1	-
8	1	-	1
9	2	-	-

5.5.3.3. All streams required for the feasible STB configuration shall be enabled using appropriate content as described in section 5.3 of this appendix. If the STB or connected client(s) support HD streaming, an HD stream shall be used, otherwise an SD stream shall be used.

5.5.3.4. Begin the multi-stream mode power consumption measurement and record the average power consumption for 2 minutes as P_{MULTI_STREAM} .

5.6. *Sleep Mode Power Measurement.*

5.6.1. Only run the test for each mode if the STB supports this functionality, as defined in section 2.25.2. If the STB cannot be placed in sleep mode as defined in section 2.25.2 using a remote control, then this test shall be skipped.

5.6.2. The time period for each test in the sleep mode (sections 5.6.7 and 5.6.8 of this appendix), T_{SLEEP} , shall be between 4 to 8 hours. The time period shall be extended beyond 8 hours only if required as described in section 5.6.4 of this appendix.

5.6.3. Assure no recording events are scheduled over the entire duration of the test, including the time prior to transitioning to sleep mode. If the STB is capable of scheduling a recording, schedule a recording 24 or more hours into the future.

5.6.4. Assure no service provider network initiated actions requiring a transition to on mode occur during the 4 to 8 hour time period that the STB is in sleep mode

(example: content downloads or software updates). If a service provider network initiated activity cannot be disabled, then this shall be monitored as follows:

5.6.4.1. The power consumption shall be sampled at a rate of at least 1 sample per second.

5.6.4.2. For input powers less than or equal to 1 W, a linear regression through all power readings shall have a slope of less than 10 milli-watts per hour (mW/h). If the slope of the linear regression is equal to or greater than 10 mW/h the test shall either be restarted or extended until a slope of less than 10 mW/h is achieved.

5.6.4.3. For input powers greater than 1 W, a linear regression through all power readings shall have a slope of less than 1 percent of the measured input power per hour. If the slope of the linear regression is equal to or greater than 1 percent the test shall either be restarted or extended until a slope of less than 1 percent is achieved.

5.6.4.4. If the test is extended beyond 8 hours to achieve the desired condition, the average power consumption over the entire test duration shall be reported for $P_{\text{SLEEP_MANUAL}}$ and $P_{\text{SLEEP_APD}}$ and these values shall be used to determine the AEC.

5.6.5. Assure no local area network initiated actions requiring a transition to on mode are scheduled during the 4 to 8 hour time period that the STB is in sleep mode (example: mobile applications or other network devices requesting service).

5.6.6. Configure the STB as specified in section 5.2 of this appendix.

5.6.7. *Manual Sleep Test.*

5.6.7.1. If the STB does not support sleep mode, then set $P_{\text{SLEEP_MANUAL}}$ equal to

P_{WATCH} .

5.6.7.2. For STBs that are capable of transitioning to sleep mode, operate the STB in the multi-stream test configuration (section 5.5.3 of this appendix) for at least 5 minutes if the STB supports multi-streaming. If the STB does not support multi-streaming, operate the STB in the on (watch TV) configuration (section 5.5.2 of this appendix) for at least 5 minutes.

5.6.7.3. Momentarily (< 1 second) press the “Power” button on the remote for the STB, and each locally connected display device and client, to place the STB, and each locally connected display device and client, into sleep mode as defined in section 2.25.2. Some STBs may require a short period of time before they actually enter a lower power consumption mode.

5.6.7.4. Do not use (or move) the STB remote control after section 5.6.7.3 of this appendix.

5.6.7.5. Ensure that the STB and each locally connected client has entered sleep mode by verifying no channel viewing or recording is supported on the STB and client(s). That is, there shall be no video output on the connected display device(s) from the STB and any locally connected clients.

5.6.7.6. Begin manual sleep mode power consumption measurement and record the average power consumed as $P_{\text{SLEEP_MANUAL}}$ over the time period as determined in section 5.6.2 of this appendix.

5.6.8. *Auto Power Down (APD) Test.*

- 5.6.8.1. Perform this test only if the STB supports auto power down as defined in section 2.2 of this appendix.
- 5.6.8.2. If the STB supports multi-streaming, operate the STB in the multi-stream configuration (section 5.5.2 of this appendix) for at least 5 minutes. If the STB does not support multi-streaming, operate the STB in the on (watch TV) configuration (section 5.5.2 of this appendix) for at least 5 minutes.
- 5.6.8.3. Momentarily (< 1 second) press the “Power” button on the remote only for any locally connected clients to place the clients into sleep mode as defined in section 2.25.2. Some clients may require a short period of time before they actually enter a lower power consumption mode. If more than one display device is locally connected to the STB, press the “Power” button for the additional locally connected display devices and stream content to one display device only.
- 5.6.8.4. Do not use (or move) the STB remote control after section 5.6.8.3 of this appendix.
- 5.6.8.5. Allow the STB to operate until the STB enters sleep mode or until 4 hours have elapsed, whichever occurs first.
- 5.6.8.6. If 4 hours have elapsed and the STB is not in sleep mode, then the unit is not considered to support APD and $P_{\text{SLEEP_APD}}$ shall be set equal to P_{WATCH} .
- 5.6.8.7. Once the STB is in APD, begin power consumption measurement in APD and record the average power consumed as $P_{\text{SLEEP_APD}}$ over the time period as determined in section 5.6.2 of this appendix.

5.7. *Off Mode Power Measurement.*

5.7.1. Place the STB in off mode. If the STB cannot be placed off mode as defined in section 2.25.3, then this test shall be skipped.

5.7.2. Wait until the STB enters off mode.

5.7.3. Record the average power for 2 minutes as P_{OFF} .

5.8. *Sleep to On Mode Transition Time Measurement.* The following test is optional and should be performed to verify that the STB's operation qualifies for sleep mode as described in section 2.25.2.

5.8.1. For the manual sleep test, place the STB in sleep mode according to the steps specified in sections 5.6.7.2 through 5.6.7.5 of this appendix. For the APD test, place the STB in sleep mode according to the steps specified in sections 5.6.8.2 through 5.6.8.6 of this appendix.

5.8.2. Once the STB enters sleep mode, wait until the STB power consumption reaches P_{SLEEP_MANUAL} (+0.5 W, -0.0 W) for the manual sleep test and P_{SLEEP_APD} (+0.5 W, -0.0 W) for the APD test.

5.8.3. After the STB power consumption reaches the desired value as specified in section 5.8.2 of this appendix, remain in sleep mode for at least 5 minutes.

5.8.4. Momentarily (< 1 second) press the "Power" button on the remote or front panel of the STB.

5.8.5. Begin the elapsed time measurement.

5.8.6. Stop elapsed time measurement when the STB enters on mode. It shall be ensured that the STB has entered on mode when it supports channel viewing on the connected display device or client.

5.8.7. The duration to transition from sleep mode to on mode shall be recorded as

$T_{\text{SLEEP_TO_ON}}$, and this value shall be used to compare against the sleep mode requirements described in section 2.25.2.

6. Calculation of the Annual Energy Consumption of the Set-top Box

6.1. The AEC of the STB shall be calculated using the rated values of power consumption in the on, sleep, and off modes of operation (see section 5.4.2 for calculation of rated power consumption values).

6.2. Compute the AEC of the STB using the equation below. The computed AEC value shall be rounded as follows:

6.2.1. If the computed AEC value is 100 kWh or less, the rated value shall be rounded to the nearest tenth of a kWh.

6.2.2. If the computed AEC value is greater than 100 kWh, the rated value shall be rounded to the nearest kWh.

$$AEC = 0.365 \times (P_{\text{WATCH}} \times H_{\text{WATCH}} + P_{\text{MULTI_STREAM}} \times H_{\text{MULTI_STREAM}} + P_{\text{SLEEP_MANUAL}} \times H_{\text{SLEEP_MANUAL}} + P_{\text{SLEEP_AUTO}} \times H_{\text{SLEEP_AUTO}})$$

Where:

AEC = annual energy consumption (in kWh per year),

P_{WATCH} = the rated power consumption value (in W) in on (watch TV) mode,

H_{WATCH} = the number of hours assigned to on (watch TV) mode according to Table 3 of this appendix,

$P_{\text{MULTI_STREAM}}$ = the rated power consumption (in W) in the multi-stream test in on mode,

$H_{\text{MULTI_STREAM}}$ = the number of hours assigned to multi-stream according to Table 3 of this appendix,

$P_{\text{SLEEP_MANUAL}}$ = the rated power consumption (in W) in the manual sleep test in sleep mode,

$H_{\text{SLEEP_MANUAL}}$ = the number of hours assigned to manual sleep according to Table 3 of this appendix,

$P_{\text{SLEEP_APD}}$ = the rated power consumption (in W) in the APD test in sleep mode,

$H_{\text{SLEEP_APD}}$ = the number of hours assigned to APD according to Table 3 of this appendix,

P_{OFF} = the rated power consumption (in W) in off mode, and

H_{OFF} = the number of hours assigned to off mode according to Table 3 of this appendix.

Table 3: Number of Hours Assigned to each STB Mode of Operation.

APD Enabled by Default?	Multi- stream?	H_{WATCH}	H_{MULTI_STREAM}	H_{SLEEP_MANUAL}	H_{SLEEP_APD}	H_{OFF}
NO	NO	14	0	10	0	0
YES	NO	7	0	10	7	0
NO	YES	9	5	10	0	0
YES	YES	2	5	10	7	0

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